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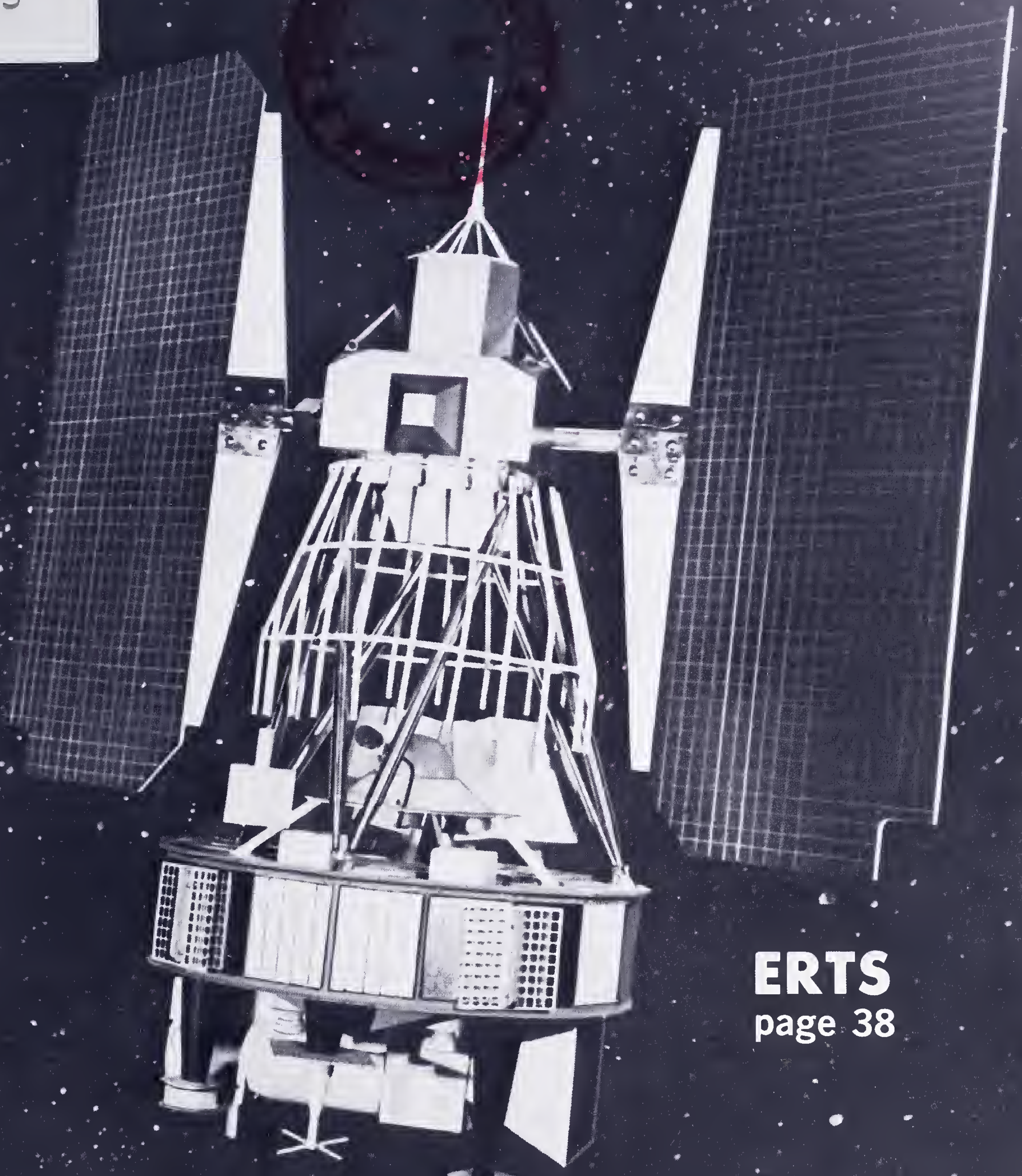

ERTS
page 38

ARMY RESEARCH AND DEVELOPMENT

August 1972

SPEAKING ON . . .

The American Way Applied to Ecology and Economic Growth

Forecasters of doomsday for America and many other nations in the world because of the severity of problems related to the ecology and the environment—demanding drastic protective and corrective programs of vast magnitude—may not be as well informed as they perhaps should be about the course of history.

That is the message Army Chief of Engineers LTG F. J. Clarke carried recently to the Huntsville (Ala.) Post of the Society of American Military Engineers. In a vigorous, prideful defense of what has been accomplished in the United States to improve the quality of life, ecologically and economically, he spoke out against ill-considered actions that could imperil economic growth and prosperity of the nation. His address follows:

LTG Frederick J. Clarke

* * *

One of the few things almost everybody seems to agree on these days is that modern civilization has gravely harmed the natural environment. It is taken as a matter of course that the blessings and benefits of our industry and technology have borne a hidden cost that is only now coming to light—a still not fully counted cost in impairment of air and water and something called the biosphere. By indulging himself with his potent but dangerous tools, man has destroyed species that evolved through the ages, and imperiled the very planet—so we are told.

The idea that modern civilization is hostile to the environment is presented as something so self-evident that it does not need proof—like those other once self-evident ideas that the world is flat, or that the sun, like the moon, revolves around the earth.

Nevertheless, I must confess that lately a certain amount of skepticism has been seeping into my mind about some of these things. I note that Nature herself has exterminated some 100 million species without any help from man at all.

The ice ages came and went, several of them, with no fancy layering of the stratosphere by man-made ions or other human intervention. Lakes died—big ones, bigger than any of our present Great Lakes—before mankind ever came along.

Just three volcanic eruptions within the past century put more ashes, dust and gases into the atmosphere than all man's activities all through the ages, from the cavemen's campfire to the Los Angeles freeway.

In other words, I am beginning to realize that some of the fears now being aroused and some of the accusations now being leveled against modern America may not be very well founded—not well enough, in my opinion, to warrant the drastic measures of social and economic upheaval being demanded in some quarters.

What's more important, I'm coming to realize that, far from causing all the environmental damage we're accused of, man and his technology have actually protected and improved the environment in countless far-reaching ways.

So my message today is that perhaps our best course might be to seek out and learn from the many examples of the beneficial use of human skill, rather than crying Mea Culpa over real or imagined mistakes of the past.

I am becoming convinced that development is not all bad—far from it—and that some of the proposals advanced in the name of the environment could be ill-advised, just as some development proposals have been.

Our best course on resource development probably is the one advised by Davy Crockett about 150 years ago: Make sure you're right, then go ahead.

Modern human skill and knowledge developed sustained-yield forestry, which gives us paper and building materials from an ever-renewable, replenishable resource—forests.

Modern man has made possible the fish and game management programs which give today's youngsters probably more fishing and better fishing in more streams than their fathers or grandfathers knew. Modern science is halting the soil erosion that in former ages clogged up rivers and formed huge alluvial plains and deltas.

What about the statement that we have ruined our rivers? Were the streams that Nature gave us pure, and are they defiled only by modern man? The first settlement in Georgia was decimated by drinking local water.

One of the Hessian officers who fought George Washington in the Revolutionary War wrote to his professor back in Germany about the "unhealthy air and bad water" of colonial Pennsylvania, which he said were all but unendurable.

Green Bay, Wisc., an arm of Lake Michigan, got its name from the great masses of algae that flourished in the water. In fact, the first French fur-traders called it Stinkard Bay.

At Concord, Mass., in the 1840s, Thoreau's friend Nathaniel Hawthorne wrote: "It is one of the drawbacks upon our Eden that it contains no water fit to drink or to bathe in." He went on to describe the Concord River as a "gross and impure" stream, and made moralizing comparisons between that river and certain people who are fair outwardly but corrupt below the surface.

A University of Kansas professor tells us that between 1880 and 1890—frontier days in that part of the world—200 to 300 people died each year in Kansas alone from water pollution. I could cite many similar examples.

So is modern human civilization to be blamed entirely for the fact that our rivers are not perfect for each of the many purposes that various segments of our population may desire?

On the contrary, I think that modern man has if anything improved many of our major streams for most purposes. To be sure, there are some short urban rivers, like the Passaic in New Jersey or the Cuyahoga at Cleveland or the Maumee at Toledo, that are in bad shape.

In contrast, our biggest river, the Mississippi, today carries only half the load of silt it used to carry. Moreover, it has been made to quit flooding, so that there is a much more attractive and healthy natural environment throughout the whole huge valley.

The great Missouri was once so muddy that it held no game fish. Lewis and Clarke found no trout in that river, but today it offers prime fishing way up into Montana.

The great river of the Southwest, the Colorado, got its name from its load of red sediment. Now, below Hoover Dam, it is clear and blue and contains game fish. The Sacramento, California's main river, has been restored from a muddy ruin to a prime trout and salmon fishery. And so on and on.

If we are truly interested in cleaner and better rivers, what course should we follow? The one that has already successfully improved many major streams? Or the one based on misconception, distorted by fear and exaggeration?

Are man's works really so obnoxious, so disfiguring? In the Middle East, Babylon and Nineveh flourished in what was once the garden spot of the world, thanks to man-made irrigation systems.

Mongol conquerors deliberately destroyed these works, and the valleys of the Tigris and Euphrates went back to their natural state and have been deserts ever since.

North Africa, in the days of Carthage, was the bread-basket of the Mediterranean. But the Romans wrecked the water resource

(Continued on page 20)

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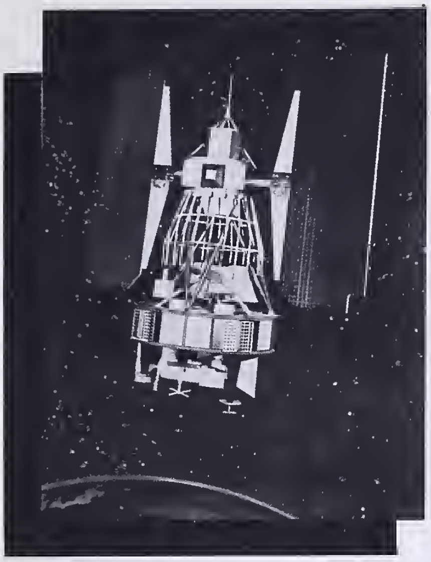

ABOUT THE COVER . . .

Artist's concept of the Earth Resources Technology Satellite (ERTS) as it circles the globe every 18 days is shown here. Launched July 23, it is now orbiting the earth and transmitting data relating to agriculture, forestry, land use, geology, hydrology, geography, oceanography and environmental science to scientists in 35 countries. The ERTS System and ground coverage pattern are described in schematic drawings on the back cover.

ARMY RESEARCH AND DEVELOPMENT

Vol. 13, No. 5 August 1972

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Editor . . . . Clarence T. Smith
Associate Editor . George J. Makuta
Associate Editor . . . Philip A. Farris

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Selective Scanner . . .

CDEC Tests Non-Conventional Training

Replacing lecturers with a buddy system of man-to-man instruction is part of an Army experiment that shows higher quality results without using more people, money or materials.

Called "Peer Instruction," the new technique was devised by the Human Resources Research Organization (HumRRO) and recently tested by the U.S. Army Combat Developments Experimentation Command at Fort Ord, Calif.

Trainees are used to train trainees, with the training broken down into one-day units. The first trainee watches an expert do his work for the first day. The next day he gets one-to-one tutoring instruction in this same work unit.

If he passes a proficiency test, on the third day he performs his newly learned tasks for the next trainee. The fourth day he instructs the next trainee in the work unit. If his protege passes the test for an expert, the two may knock off the rest of the day. Thus, the trainee goes through the same work unit four days running, tackling the same work unit from four entirely different angles in very much his own style.

The full-scale field tests at Fort Ord were run with excellent results. Fewer men in the experimental group had to be recycled or dropped from the course than in a comparison group. All members of the experimental course graduated at the 100 percent mastery level. None of the conventionally trained men did. Thus, the field test showed the pattern to be much higher-quality results, regardless of trainee ability, in the same training time.

Researchers explain this method of Peer Instruction in a bulletin titled Professional Paper 6–71, "The APSTRAT Instructional Model," which is available from Human Resources Research Organization, 300 North Washington St., Alexandria, Va. 22314.

Lightweight Rocket Launcher Tested

Preliminary tests indicate a fiberglass prototype rocket launcher, designed and fabricated by a materials engineer of the Feltman Research Laboratory (FRL) at Picatinny Arsenal, Dover, N.J., offers advantages over one made of aluminum.

Weighing 30 percent less and having lower conductivity, the fiberglass launcher is said to be less susceptible to rocket cook-off and fire damage. Because of the need for lightweight weapons systems, the 19-tube 2.75-inch M200 prototype was picked for the feasibility tests.

With the cooperation of the U.S. Army Missile Command (MICOM), Roy Blajda of FRL designed the test model by making major structural components from fiberglass yarn and glass cloth impregnated with epoxy resin.

Individual launch tubes reportedly showed damage or erosion after firing 138 rounds. More than 250 rounds were fired in 19-shot ripples, to test the launcher's ability to withstand structural loads induced by multiple launches, and in single firings to determine wear characteristics of the tubes and bulkhead caused by the rocket exhaust.

In follow-up development, stress will be placed on improving performance, further reducing weight and cutting manufacturing costs.

Ray Blajda

MERDC Evaluating Containerization Trucks

Trucks capable of handling military cargo containers under varying conditions are an important factor in the Department of Defense containerization system development program to reduce costs in handling military hardware.

Two trucks designed to handle 8 by 8 by 20 foot containers with loads up to 44,000 pounds are being evaluated at the U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.

One is a commercial side-loader capable of stacking three containers high and traversing in aisleways less than 16 feet. Transportability, ease of operation, and reliability and performance are among the features being evaluated.

The second truck configuration is a commercial modification being evaluated for operation in sand or other soft terrain found in over-the-beach movements. A front loading machine, it is basically a bucket loader in which a heavy lift mast has replaced the bucket.

Small Arms Systems Agency Sponsors Seminar

State-of-the art information on small arms weapon technology was presented recently to the industrial small arms community in a seminar at the Aberdeen (Md.) Proving Ground.

Sponsored by the U.S. Army Small Arms Systems Agency (SASA), the meeting was attended by 44 industrial technicians representing 24 companies. Experts also represented the U.S. Army Weapons Command, Frankford Arsenal, Army Materials and Mechanics Research Center, Aberdeen Research and Development Center, and the Foreign Science Technology Center.

Participating agencies presented technical reports on current developmental efforts in the Army's small arms program.

COL Raymond S. Isenson, SASA commanding officer, stressed that the seminar was intended to bring the results of the Army's in-house laboratories in small-arms research to the attention of industrial weapon systems engineers of firms interested in Army contracts.

TOW Missile Proves Merit in Vietnam Combat

Combat use of the TOW (Tube-launched, Optically-tracked Wire-guided) system in Vietnam during recent operations marked the first time the U.S. Army-developed missile has been fired in battle.

Pulled out of a test program at Fort Lewis, Wash., two UH-1B Huey gunships equipped with the airborne TOW system "killed" 24 tanks and blasted 21 other point targets including armored personnel carriers, trucks and howitzers in less than two months of combat.

A limited number of ground-based TOW systems in Vietnam have killed 10 tanks and destroyed 6 bunkers, including 4 in a single action near Fire Base Nancy northwest of Hue during the night of June 24.

The TOW Project Office, assisted by other elements of the Missile Command (MICOM) and Army Materiel Command (AMC), coordinated the deployment of the airborne- and ground-based systems.

Pilots from the Combat Developments Command who had been flying the Hueys in the Fort Lewis tests went with the helicopters to Vietnam.

Summarizing what he had observed in the highly successful combat role of Army helicopters firing the TOW, Director of Army Aviation BG William J. Maddox said:

"A major new dimension has been added by their now proven effectiveness using the TOW missile against modern tanks as well as against other important point targets. With so few having proven so effective in Vietnam, it is now possible to visualize more clearly the great antitank potential larger numbers of modern attack helicopters and TOW missiles would bring to a modern Army division."

He praised the accuracy and reliability of the airborne TOW system and said it would be mounted on the Cobra gunships.

MICOM Tests Cobra for Laser-Guided Missiles

A test program to qualify the AH-1G Cobra helicopter as a launch ship for laser-guided missiles is under way at the U.S. Army Missile Command (MICOM), Redstone Arsenal, Ala.

The tests are part of a continuing MICOM program to investigate and accumulate technology in missile terminal homing guidance. Semiactive laser guidance is a technique developed in MICOM laboratories. After the missile is fired, it homes on a target illuminated by a laser beam.

To certify the Cobra, the MICOM Guidance and Control Directorate has designed launch equipment to accommodate four test missiles. Dr. John L. McDaniel, director of the Research, Development, Engineering and Missile Systems Laboratory, stated that the initial plan is to fire about 15 missiles from ground platforms, then from the air, and at a variety of moving and stationary targets to qualify the Army's Cobra gunship as a missile attack helicopter.

The Cobra is faster, more maneuverable and presents a smaller silhouette than its predecessor, the UH-1C Huey. Adapting it to laser terminal homing makes possible the use of future weapons with direct and indirect fire capabilities in air or ground roles.

TRMF Assesses Hawk Missiles

Giving the Army a computerized test capability for assessing samples of deployed Improved Hawk missiles, the first Theater Readiness Monitoring Facility (TRMF) was delivered recently to Red River Army Depot, Tex.

Staffed and equipped there, the facility utilizes equipment identical to the final missile test equipment at the Raytheon Co. production site. Delivery was made to the Army Missile Command contract officer at the depot.

By sample testing under controlled environmental conditions, known variables are eliminated. An accurate system trend prediction is provided for the Certified Round Improved Hawk missile with respect to effects of handling, transportation, storage and aging.

The Improved Hawk, development of which was started in 1964 to incorporate continuing technological advances, features a completely redesigned missile with new guidance package, larger warhead, and improved motor propellant.

Reliability in performance is upgraded by use of all solid-state components. The maintenance burden in the field is less because the missile goes directly from the production line to the user as a "Certified Round." No maintenance or test is required at the fire unit or direct support maintenance level.

Picatinny Celebrates Dover Anniversary

Picatinny Arsenal and Dover, N.J., joined hands in celebrating the city's 250th anniversary in August.

The arsenal, which has played a big part in the development and economic life of the community, had its beginning in the mid-1700s when blacksmith Jonathon Osborne came to the area because of its abundant water, iron ore mines, and firewood trees.

Now, some 200 years later, Picatinny has become the nucleus of the Dover economy, having the largest payroll and number of employes in Morris County.

The mutual celebration featured sports events, parades, a beauty pageant, exhibits, concerts, and the wearing of beards by men—"Brothers of the Brush."

Highlight of the affair was a performance dramatizing the history of Dover from Indian times to the present.

WSMR Tests Mars Lander Parachute System

The first of three balloon launches scheduled for testing the Viking Decelerator System was successfully carried out recently at White Sands (N. Mex.) Missile Range.

Simulating conditions expected in the Mars unmanned landing planned about 1976, the test used a giant polyethylene balloon in the thin atmosphere over the range.

After floating over the range, the balloon dropped the Mars lander gently to earth, cradled under a group of parachutes. Spokesmen for the National Aeronautics and Space Administration White Sands test facility said telemetry data from the flight are being analyzed, but preliminary indications show that conditions prescribed for the test were achieved.

Launching of the second balloon is scheduled as soon as equipment can be readied when weather conditions permit. The purpose of the three tests is to qualify the parachute system for the range of environments anticipated in a Mars landing.

WSMR officials believe the test vehicle was the largest experimental balloon system ever successfully flown, with a payload weight of around 5,000 pounds.

Amplification of Field Telephone Improved

Improving an amplifier used in Vietnam, CPT John I. Bruno and SFC Arthur R. Shannon of the 82d Airborne Division, Fort Bragg, N.C., have developed a water-proof speaker system for voice amplification with the TA-312 field telephone.

Compact and simple to operate, the device allows everyone in the Fire Direction Control Center to hear commands clearly. This reduces the chance of human error, increases efficiency, and gives the chief of the M-102 howitzer section time to supervise and control his section.

The TA-312 field telephone amplifier operates on a BA-200 (6-volt DC) battery which has a life expectancy of two weeks if used continuously. Plans call for production of 70 amplifiers for use throughout the 82d Division Artillery.

Fast-Burst Nuclear Reactor Record Claimed

Claims for an operational record were advanced for the fast-burst nuclear reactor at White Sands Missile Range, N.Mex., when its first uranium fuel core was replaced after carrying out more than 5,000 research experiments.

The 5,000 mark is believed to be a record run for a nuclear reactor of this type in the United States. The new core incorporates changes expected to increase significantly the nuclear output characteristics at the Army Missile Test and Evaluation facility.

The reactor is used by Department of Defense agencies, universities, industry and other governmental agencies. Experimental programs include transient radiation effects studies on electronics, dosimetry experiments, and radiobiological programs.

Components of the old reactor core, in continuous operation with essentially its initial charge of fuel since August 1964, have been sent to Albuquerque for evaluation by Sandia Laboratories and the Los Alamos Scientific Laboratory. Results are expected to contribute to the development of fuel materials and design concepts.

MG Arthur H. Sweeney Jr., WSMR CG (right), fits fuel ring in fast-burst reactor with help from John R. Dodd.

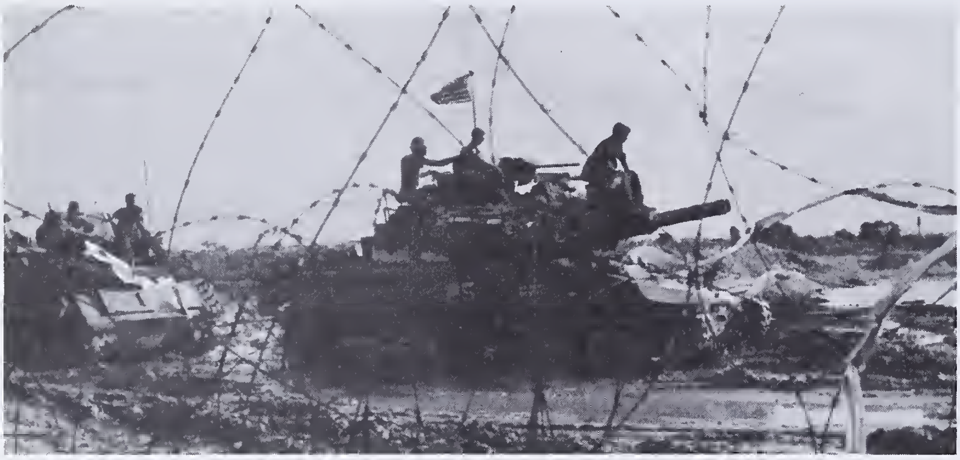
The Decade of AMC . . .

'A Tradition of Excellence'

Aug. 1, 1962, ranks among major milestones in the United States Army's transitional history—a day that marked completion of an epochal wide-ranging reorganization, dominated by creation of the Army Materiel Command as a merging of materiel functions of six of the seven Technical Services.

"Empowered as no other command in U.S. Army history," the Army Research and Development Newsmagazine *reported, "the AMC directs activities of depots, laboratories, arsenals, proving grounds, test ranges, procurement offices, and transportation terminals throughout the continental U.S."*

Involved in the vast reshuffling of functions and operational responsibilities at that time were about 166,000 civilian employes and 20,000 military personnel, an inventory of $23.5 billion, and estimated annual expenditures of approximately $7.5 billion.



M-551 Armored Reconnaissance Airborne Assault Vehicle, being guided through heavy Vietnam mud by soldiers of the 25th Infantry Division, offers graphic evidence of the AMC research, development and supply support provided for troops in Southeast Asia.

Upon the occasion of a "Decade of Progress," AMC leaders can look with pride upon vigorous and successful responsiveness to the tremendous challenges of the rapid buildup in capabilities to wage the war in South Vietnam. Leaders stressed that they must look also to the challenges of the future—learning to do more with decreased resources.

Confronted in 1962 with a situation of unprecedented operational complexities, Army Materiel Command organizers responded by setting three broad goals:

First, the new organization had to be responsive to the Army's needs for materiel and logistics support. Second, a single Army wholesale logistics system had to replace the traditional methods used by the Technical Services absorbed within the AMC. Third, the changes had to yield improved efficiency and cost savings.

With unexpected suddenness, the war in South Vietnam produced a proving ground for the soundness of the organizational concepts of those

STARLIGHT SCOPE, developed at AMC's Night Vision Laboratory, Fort Belvoir, Va., is one of a series of night vision devices credited with "taking the night away from Charlie" in Vietnam warfare.

THE U.S. ARMY MATERIEL COMMAND . . .

Consists of a nationwide network of 83 military installations and more than 100 activities—including four corporate laboratories, and three Army Service schools.

Is responsible for the materiel functions formerly performed by six of the Army's Technical Services (Ordnance, Signal, Quartermaster, Engineer, Transportation, and Chemical). Included are research and development, test and evaluation, procurement and production, storage and distribution, inventory management, maintenance, and disposal.

Manages a $30 billion inventory and an annual expenditure of approximately $9 billion.

Directly employs 12,400 military and 131,000 civilian personnel.

Is headquartered in Washington, D.C. area with nine subcommands, and depots, laboratories, arsenals, maintenance shops, proving grounds, test ranges, and procurement offices throughout the United States.

The nine AMC major subordinate commands are:

- *U.S. Army Aviation Systems Command (AVSCOM), St. Louis, Mo.*
- *U.S. Army Electronics Command (ECOM), Fort Monmouth, N.J.*
- *U.S. Army Missile Command (MICOM), Redstone Arsenal, Ala.*
- *U.S. Army Mobility Equipment Command (MECOM), St. Louis, Mo.*
- *U.S. Army Munitions Command (MUCOM), Picatinny Arsenal, Dover, N.J.*
- *U.S. Army Tank-Automotive Command (TACOM), Warren, Mich.*
- *U.S. Army Weapons Command (WECOM), Rock Island, Ill.*
- *U.S. Army Test and Evaluation Command (TECOM), Aberdeen Proving Ground, Md.*
- *U.S. Army Safeguard Logistics Command (SAFLOG), Huntsville, Ala.*
- *Operates CONUS Army Depot System consisting of six General Supply Depots, four Ammunition Depots and six General Purpose Depots. The System employs approximately 42,000 military and civilian personnel who have a wide variety of technical and logistical skills.*

who planned the Army Materiel Command structure.

Former Army Chief of Staff General William C. Westmoreland, who commanded the war effort in Vietnam for 4½ years, attested to the manner in which the AMC responded to this challenge by saying:

"The success of our fighting forces in Vietnam is a direct reflection of the Army Materiel Command's ability to keep the fighting men supplied with the best and most advanced materiel."

AMC had performed well during the Cuban and Dominican crises. In Vietnam the staggering requirements of building up and supplying an Army halfway around the world, and over a prolonged period, left no doubt as to the new organization's capability of meeting the first goal.

In Southeast Asia, AMC materiel and logistics support included construction equipment and supplies to build bases, ports, airfields, and communications centers; movable piers that helped speed up port construction; and containerization that not only facilitated supply but provided storage in emergencies.

The second goal, to develop a single Army wholesale logistics system to replace six Technical Services systems, has been accomplished with restructured functional management.

A notable improvement in the AMC functional structure was the adoption in 1969 of the Headquarters deputy commanding general organization. Under this concept, the principal deputy commanding general is the commander's alter ego with responsibility for management of personnel, money and facilities.

OPERATOR TESTS EVEN SPEED rolling of solventless sheet propellant at Picatinny Arsenal Ammunition Development & Engineering Directorate, MUCOM.

ARMY GLASSBLOWERS William Chabot (right) and Hugo Biermann put finishing touches to an intricate research tool they constructed at Edgewood (Md.) Arsenal. Through contribution of hundreds of people with such highly specialized skills, AMC works to insure that the best possible materiel is provided to the U.S. soldier and to allies of the United States.

Similarly, the deputy CG for Materiel Acquisiton focuses on the development, engineering and industrial base; the deputy CG for Logistics Support on support for the Army in the field; and the deputy for laboratories on the scientific community.

Another functional management development was the formulation and implementation of the Army Supply and Maintenance System (TASAMS). Devised mainly by the now disestablished subordinate Supply and Maintenance Command, this system integrated and improved the control over materiel programming, storage, distribution and maintenance. It firmly established and standardized supply and maintenance procedures in the basic commodity organizations.

Technical Industrial Liaison Offices have been established at AMC installations to provide scientific and technical data to the industrial community. Results have proved mutually beneficial to the military and to industry in contributing to accomplishment of the Army research and development mission.

Many figures can be used to point out proof of achieving more efficiency and economy—the third goal. The one that stands out is that AMC now operates with 50,000 fewer people than the Technical Services had in 1962.

Achievements in the Cost Reduction Program have maintained a high level—before, during, and after the Vietnam buildup. Validated savings have exceeded Department of the Army and Department of Defense goals every year since AMC's inception. More than $1 billion in savings has been realized during the past five years.

A typical example is the reduction in the Army's bulk petroleum storage from a pre-1964 level of $31.6 million to $5.5 million, with a one-time savings of $26.1 million and annual savings of $1 million in operational and maintenance costs.

While providing materiel to Vietnam, AMC has continued to pursue its short- and long-range functions in research and development of weapons and equipment for the Army. To manage more effectively certain high-interest technical areas in which several laboratories are engaged, AMC has recently emphasized the Lead Laboratory Concept.

The designated lead laboratory for a specified technical or tech-

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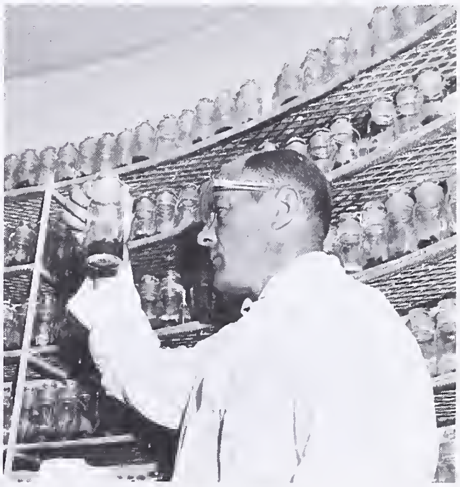


STABILITY OF PROPELLANTS at varying temperatures can be crucial to the effectiveness of weapons that must rely on the power offered by the propellants. Here, Norris Garmon, supervisor of stability and environmental testing for Feltman Research Laboratories at AMC's Picatinny Arsenal, examines effect of the controlled atmosphere upon a sample.

The Decade of AMC . . .

'A Tradition of Excellence'

(Continued from page 5)

nology area coordinates efforts of other AMC laboratories working in that area; formulates and defends the program; and receives and distributes the related program funds.

Technology areas currently included under lead laboratory managership are: camouflage, countermine, fluidics, guidance and control/terminal homing, high-energy laser, low-energy laser, human factors engineering, materials, night vision, nuclear effects and vulnerability. The designated areas are not static; programs are continually reviewed and revised as warranted by requirements.

Major items introduced into combat as a result of AMC laboratory research and development include the M16 rifle (later product improved under contract), the M79 40mm grenade launcher, General Sheridan Reconnaissance Vehicle, and the Starlight Scope.

An outstanding example of AMC's hundreds of R&D projects was the miniaturization of the AN/GSA-77 (Battery Terminal Equipment). This small and highly reliable item replaces the Fire Unit Integration Facility and Code Decoder Group for integration of the Nike Hercules and Hawk Missile System with the various Army Air Defense Command Posts.

Significant developmental achievements included reductions in weight from 4,000 to 128 pounds; in size from 700 to 3.7 cubic feet, and in power requirements from 7,000 to 170 watts.

RADIOMAN with 1st Cavalry Division moves through smoke from smoke grenade dropped from an OH-13 helicopter, marking areas to be checked out as possible Viet Cong supply bunkers. AN/PRC-25 radio (strapped to his back) has been affectionately dubbed by soldiers "the best damned radio in Vietnam."

Other R&D accomplishment listed by the AMC include:

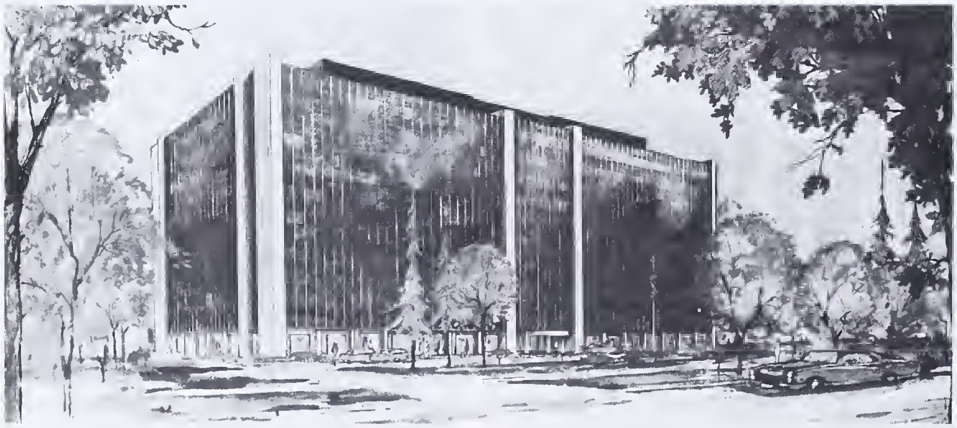
- Development of conventional munitions with significant increases in firepower effectiveness.
- A tropical boot that provides a watertight seal between the sole and the upper part of the shoe, is lighter in weight than previous types, needs no break-in period, and ends the need for field repair.
- Families of tactical missile systems that give the soldier more firepower and protection against tanks and attacking aircraft.
- The AN/PRC-25 manpack radio set, a tactical radio that had been called "the best damned radio in Vietnam."
- Ceramic torso shields, worn by aircrewmen in Vietnam, that resulted in the saving of many lives.
- Magnesium dry batteries that last more than twice as long as the zinc-carbon type.
- Image-intensification night-vision devices to give a clear picture of any desired target in darkness.
- A family of armed helicopters developed and integrated into the Army system, resulting in increased firepower and mobility.
- Improved aircraft crash survivability by improved design and equipment. The most notable advance is the crash-resistant fuel system which significantly reduces the incidence of crash fires.
- A new floating tactical bridge which can be emplaced four times faster than the bridge it replaces and requires a fifth of the manpower to erect.
- Exploitation of the freeze-drying process of preserving food for feeding of combat forces.

Maximum use of tire retreading is an excellent example of AMC's Cost Reduction Program, which has produced numerous noteworthy results. During the past 18 months utilization of retread tires has been increased from 30 to 58 percent—465,000 tires retreaded with estimated savings of $15 million.

The AMC has two depots, Red River and Tooele, specializing in retreading for the purpose of training and retaining a minimum in-house capability as a base for expansion in the event of mobilization.

AMC reorganization has completely restructured the former maze of independently administered Technical Services depots into a centrally directed network. Hundreds of rules and regulations, policies, and procedures used by the Technical Services were revised and many were combined. New and improved procedures were developed to keep pace with the computer age and advancing management techniques.

Vietnam provided AMC managers with an opportunity to test new



AMC 11-STORY HEADQUARTERS BUILDING (artist's drawing), near Cameron Station, Va., north of the Capital Beltway, will be centrally air-conditioned, have parking facilities for 1,800 cars, and include a shopping area and cafeteria with other facilities.

procedures and techniques under severe actual combat conditions. Typical of the many lessons learned from Vietnam is that maintenance must be an integral part of system or equipment design; also, maintenance support must be mobile and durable in the field.

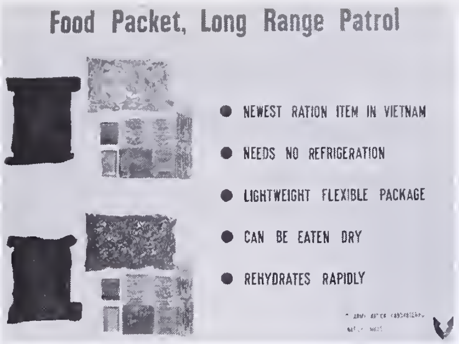
Looking to the future—what's in store for AMC in the next 10 years? Those most qualified to forecast the prospects point to the fact that AMC is definitely people-oriented and must be concerned as to what happens to its military and civilian personnel.

The next few years will no doubt see military personnel starting more stabilized assignments with AMC, some as long as five years. Those assigned to AMC will have higher education levels and those who desire to return to education development programs will be encouraged. The AMC already has an Army "first" with an educational goal for senior NCOs (E7, E8, and E9) to attain at least two years of college equivalency.

Expected also is a big change among AMC's civilian workers. In 1973 and 1974 slightly more than 20 percent of the technical and professional personnel currently in key positions will be eligible for retirement. This will mean new leadership in key management and technical mission-oriented jobs.

In the future, the forecasters see the AMC achieving expansion in the field of communications between AUTODIN terminals and ADP computers, with improved message distribution systems, and greater standardization of communications software and hardware.

Envisioned also are many improvements in the management areas, such as increased use of quantitative analysis techniques; also, changes in the materiel-acquisition process to reduce development time and end-item costs, and to increase over-all performance effectiveness.


Food Packet, Long Range Patrol
● NEWEST RATION ITEM IN VIETNAM
● NEEDS NO REFRIGERATION
● LIGHTWEIGHT FLEXIBLE PACKAGE
● CAN BE EATEN DRY
● REHYDRATES RAPIDLY

Forecasters say the AMC will be increasingly oriented toward the Service Center Concept, which is the centralization of automatic data processing functions at a single location to provide management information services to satellited depots, thus reducing overhead and operating costs. The trend will be toward fewer installations for savings in overhead through consolidation of activities.

Predicted also is that there will be a trend toward more centralized control of data management, especially with the adoption of AMC's Standard Automatic Data Processing Systems.

Decentralization of command control and the placing of more authority in the hands of subordinate commanders "are definitely planned for the future."

A fully implemented Modern Volunteer Army, it is believed, would benefit the AMC, in that it would provide the opportunity to retain personnel over a longer period of time and permit training of career personnel in higher level skills.

AMC's efforts are not expected to be confined strictly to defense needs. Development of air and environmental pollution control methods by AMC, it is claimed, has helped to lead the way for the entire country. Fluorescent particle tracer techniques developed at Deseret Test Center have become standard for a majority of today's environmental studies.

In looking to the future, GEN Henry A. Miley Jr., commanding general, says: "AMC was built on the foundation of the Army's Technical Services. Although AMC itself is relatively young, it is the inheritor of a proud tradition of technical excellence and responsive logistics support. This tradition goes back to the early days of our nation's history. AMC employs thousands of men and women, both military and civilian, in its offices, depots, laboratories, arsenals, industrial plants, and proving grounds. These dedicated people are committed to upholding AMC's tradition of excellence."

To All Members of the U.S. Army Materiel Command

For the past decade, we of the Army Materiel Command have been deeply involved in insuring that our Modern Army is the best equipped and most flexible land force in history. The challenges have hastened our maturity, as we built a record of solid achievement upon almost two centuries of tradition inherited from the Technical Services.

All of you have contributed, individually and collectively, to our record of success. By welcoming the responsibilities, generating the ideas, and shouldering the burdens, you have truly made this a "decade of service" by the Arsenal for the Brave.

As we proudly celebrate our Tenth Anniversary, we can remember the hectic beginnings, the turbulences caused by shifting priorities and fluctuating resources, and the ever-present challenges to perform more effectively and more efficiently. From this past, however, has emerged a veteran component of the Army, tried and tested, and fully capable of meeting the logistical demands of the combat soldier.

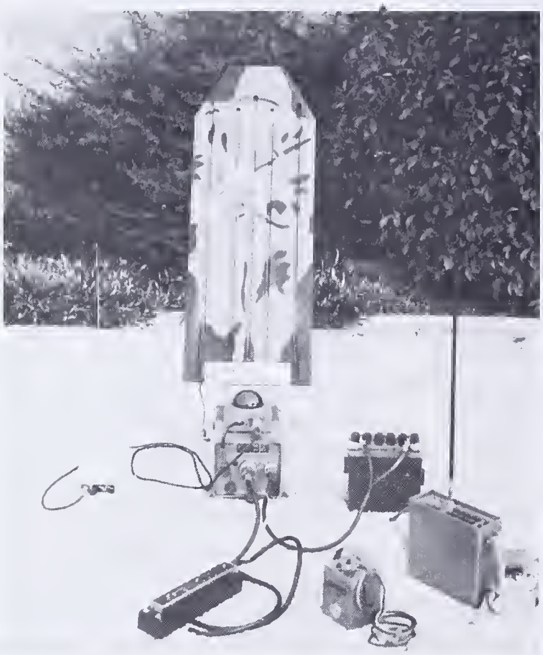
I congratulate you on your distinguished performance. I thank you all for your loyal continued support, dedication, and professional performance. I know you share my confidence that our second decade will see even greater accomplishment by the AMC Team.

Henry A. Miley Jr.

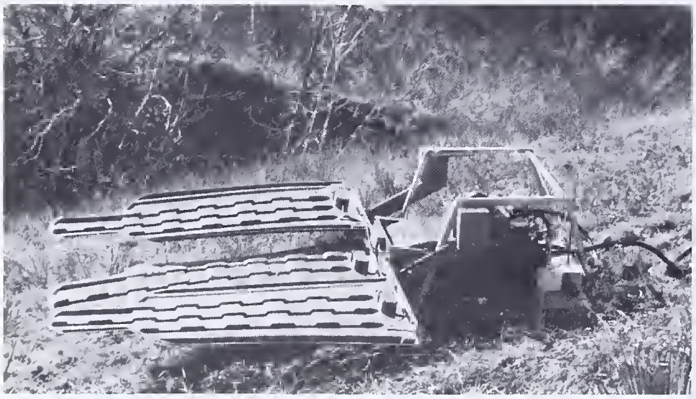
HENRY A. MILEY, JR.
General, United States Army
Commanding

DART . . .

Being tested and evaluated as new target system to improve the Army's small arms firing training



COMPONENTS for DART Portable Systems



TRIPLE TARGET Arm in Down Position

A quarter-pound demolition charge explodes near a clump of bushes, a single rifle round echoes close by, and a human-like shadow emerges from a dimly lit area off to the right—all in only a moment.

Seconds later the series of events is repeated, but this time, instead of popping up, the shadow swings from behind a rock while a third silhouette appears just ahead, moving from left to right.

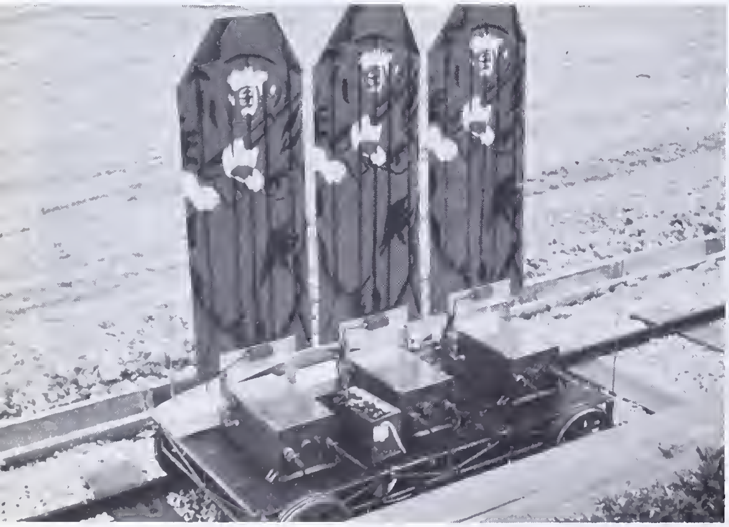
This script might describe an ambush. It could be part of a war movie scenario. In reality, however, it is part of a new target firing system being tested at Fort Carson, Colo., and Fort Knox, Ky., as a possible replacement for the Army's Trainfire System now in use, or to improve it.

Known as DART (Disappearing Automatic Retaliatory Target), this new system was developed in Australia. In addition to the Army evaluation being conducted at these two posts, the Marine Corps and the FBI are running tests on DART at Quantico, Va.

Fort Carson testing is being done under actual conditions that will be encountered once the evaluation is completed. At this mountain post, as is true of other Army installations, training on firing ranges has been limited to rows of troops shooting at rows of pop-up targets at various distances. This technique has relied on commercial electrical power to function or on large generators with miles of wiring.

Referring to the system in use, MAJ Robert Burke, Fort Carson range control officer, said, "If we had a power failure with the old system, the whole range was forced to shut down."

Talking about DART, he noted that "each unit out



TROLLEY Arrangement for Triple Target

STREET-FIGHTING Position of Target

in the range is powered by a 12-volt battery similar to the one in an automobile, while the main console operates on nickel-cadmium batteries."

The system is composed primarily of the target-operating mechanism and the command console. Targets down range are set up on a raising and lowering device weighing approximately 70 pounds. They are remotely controlled from behind the line of fire by the console operator, as are the demolition rounds and exploding caps that give the system its retaliatory capability in the form of a simulated shot fired at the trainee.

DART's two basic systems are: Static and Portable. While both function in the same manner, the portable system is radio controlled. The control console can be fixed or portable. A telemetry relay unit directs signals to the correct target, and also relays the hit and target-up signals to the console unit.

Unlike the old target system, DART does not require wiring from the console to targets.

The target mechanism permits four basic movements: a sideways motion which can be used as a window target, a street-fighting target which might simulate a figure in a doorway, a tree- or building-mounted target simulating the position of a sniper, and a group target allowing the shooter to discriminate between combatants and noncombatants.

Targets will not retract if struck by flying dirt from a low round or by strong winds. Even ricochets or gravel picked up and thrown against the target are ignored by the console's discriminating hit indicator. The DART system can bring up an 80-pound target in a 50mph wind and will count only bullets, of any caliber, going through special polyethylene targets.

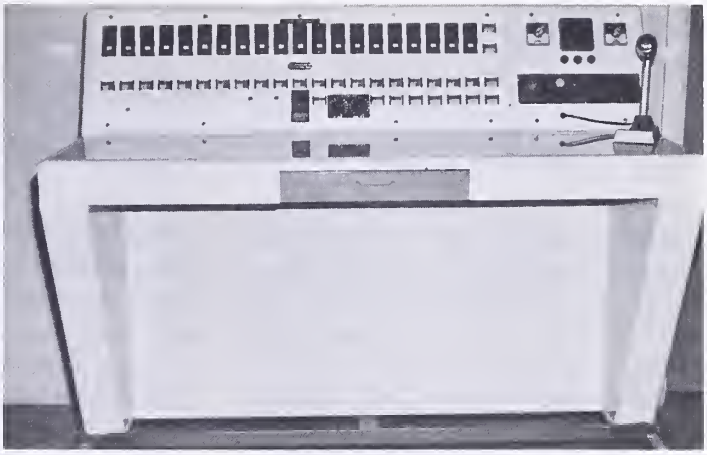
The command console, with a range of 1,500 meters, can effectively function with 10 channels. Each channel has a capability of operating four separate target operating mechanisms and their retaliatory faculties. In turn, each mechanism is capable of performing with one, two, or three silhouettes attached, thus giving the entire system the ability to show 120 synthetic figures at one time.

The silhouettes can either pop up from their pit, swing out from behind an obstacle, or appear from one side of the pit and shift to the other, in a fashion that is similar to a shooting gallery.

A night-shoot attachment can be quickly installed on top of the target mechanism. This includes an indicating dome that is half orange and half white. The orange half faces the shooter from a protected position and glows for 2½ seconds when the illuminated target is hit.

The white half of the dome faces the target, illuminating it for one-half of a second each time a simulated shot is fired. This shows the shooter the target's position. The light may be turned out as shooting skill increases.

A retaliatory device attached to the target mechanism is fitted with 24 detonators. These can give 24 simulated shots and also be used to detonate explosive charges, simulated grenades, mines, or any other type of explosives. Another component can accurately count hits on a target at 1,500 rounds per minute.



COMMAND CONSOLE, 20-lane model, with public address system used in the Disappearing Automatic Retaliatory Target.

DART is limited to direct-fire training, with capabilities ranging from the .45 cal. automatic pistol to the .50 cal. machinegun. The system being tested has been utilized on pistol ranges, infantry attack courses, and tank tables at Fort Carson.

"With DART we can make Trainfire much more realistic for the soldiers," added MAJ Burke. "We will be able to set up lanes where the men will maneuver during either night or day and encounter targets, simulated rifle firing, and demolitions at various points and distances."

He praised the system further by saying that "once it is initially in an operable position, manpower and labor expenditures will be trimmed by 50 percent." DART can be considered a completely automatic firing range requiring only one operator.

In addition to Fort Carson's preliminary satisfaction with the new system, Seventh Army personnel in Europe indicate that DART is a considerable improvement over the M30A1 target mechanism currently used.

Two more DART systems will be purchased by the Army in the near future, to be placed at Fort Bragg, N.C., and Fort Polk, La.

RETALIATORY DEVICE being loaded with detonator caps.

Try CIDS . . .

Army Chemical Information, Data System Applies High-Speed Computer Techniques

Would you like to identify all chemical compounds containing one or more specific (or general) functional groups without having to inspect every total compound in a formula index? Try CIDS.

Do you know the various nomenclatures of a particular compound which have been assigned to the chemical literature? Try CIDS.

Are you in a hurry for information on specific compounds or families of compounds? Try CIDS.

Would it save time and effort to pinpoint the information available on only specific characteristics of a particular compound?

Then by all means call on the Army's Chemical Information and Data System (CIDS), which has been converted from its developmental configuration to the UNIVAC 1108 computer at Edgewood Arsenal, Md.

Under development since 1964, the system implements a major concept of the Army's Scientific and Technical Information (STINFO) Program—the application of high-speed computer techniques to the search for chemical information.

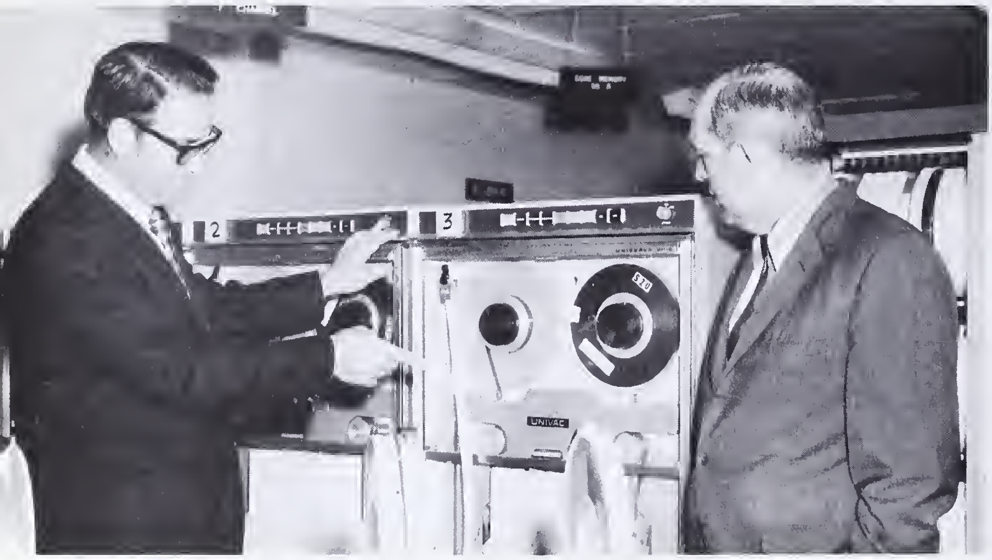
CIDS applies a permanent registry number to each unique chemical structural formula input to its data bank. It subdivides the molecular structure almost infinitely to permit a search for chemical information based on any number of user-defined substructures in any logical combination.

Depending upon the needs of the user, this information is relative to the content of each identified source document as well as the chemical requirements. Searches currently conducted by punched-card input at the arsenal's central site require an estimated 24-hour turnaround time.

Each output, in the form of a single record for a responsive compound, depicts structural and molecular formulas, the permanent registry number, nomenclatures assigned in the source document, and information identifiers related to each reference.

By the third quarter of FY 1973, on-line searches via teletype equipped with an extended type style will permit record output directly at the console. This will reduce turnaround time for remote users on commercial telephone lines.

Three of these specialized teletypes (Model 37) will be located at Edgewood Arsenal and four at selected Army Materiel Command and other Army installations. The central site teletypes will be directly interfaced with those at the Computer Systems Branch at Walter Reed Army Institute of Research. In addition, the CIDS charter calls for terminals at a Navy and an Air



CIDS project officer Stanley A. Goldberg makes a point about the magnetic tape drive of the UNIVAC 1108 computer to Wayne H. Anderson, chief of the Techniques Division.

COMPUTER OPERATOR Clara H. Goff conducts an on-line search for chemical information on a special CIDS teletype.

UNIVAC 1108 high-speed computer houses data for Chemical Information Data System which operator William K. Walker can release almost instantaneously upon request.

Force installation.

CIDS punched-card searches respond to questions received by mail or telephone or during visits to the Arsenal's computer center.

Questions received at the central-site teletype via teletyped structural and narrative depictions from sites maintaining chemically modified teletype 37s will receive responses by punched paper tape, generated at the central site and transmitted over commercial telephone lines.

Personnel at remote on-line sites trained in query formulation and system use will have direct service to their local consoles from the UNIVAC 1108. Implementation of this mode is not intended to eliminate prior users whose traffic volume or resources cannot justify expansion to that level.

Major characteristics of CIDS which are unique in the computerized chemical information field include:

- Updating of existing records with new or amended information when registry routines indicate an input compound is already on record in the data bank.
- Callout by registry number only to determine if new information exists on a previously retrieved compound.
- On-line editing capabilities enabling users to modify search parameters already entered into the system without regenerating the entire search sequence.
- Magnetic tape generation of high-volume responses enabling printout of accessions on an off-line high-speed printer that graphically depicts structural formulae and associated information.

Future plans include: (1) augmentation of the system to enable identification of individuals who previously received responses identical to those retrieved by subsequent queries; and (2) the additions of hardware which will permit direct input to the data bank's registry tapes from remote teletype stations.

"These two features," stated Stanley A. Goldberg, CIDS project officer, "will significantly round out the services CIDS can provide. The first will augment what is generally referred to as the 'invisible college' by enabling those receiving information to identify colleagues who might have similar interests or have developed further information on compounds which have not yet been entered into the system.

"The second is the only viable alternative to the unrealistic number of editors which might be required at the central site to capture information in a discipline which generates a veritable flood of literature. To approach even a semblance of totality, the entire chemical community must participate in feeding hard-core information into the central data bank."

As director of the Arsenal's Management Information Systems Directorate, Goldberg is confident the operation of the Army's newest information system will prove advantageous and profitable.

"The ultimate objective is maximum product from the application of resources," he said, "and the government manager measures profit by the best return for the taxpayer's dollar.

"The major products of chemistry are discovery, knowledge and new applications; the raw material is information developed by previous work. If we minimize the time and effort expended to acquire that information, the resources thus made available for work in the laboratory will help maximize the scientist's productivity.

"Our short-range objective is to validate CIDS-predicted value to the chemist over a one-year experimental operational phase. Necessary augmentation of services and file content for further expansion will become evident through user evaluations and recommendations.

"Obviously, physical expansion is controlled by budgeted resources. User participation and contribution of data to the files by those users are the real resources that will maximize the effectiveness of the system to the chemical community. In this respect, we invite all Army installations to provide us with that type of support."

Organizations interested in utilizing CIDS are asked to contact Goldberg at Edgewood Arsenal, SMUEA-MI, Edgewood Arsenal, MD 21010 or AUTOVON 584-2807.

Army Deactivating First Nuclear Power Plant

What often has been hailed as the world's first nuclear power plant—the origin of a multibillion dollar proliferation of large and sophisticated plants to meet the huge increase in demand for electrical power—is scheduled for deactivation in May 1973.

Operated by the U.S. Army Corps of Engineers and known as the SM-1 nuclear power plant at Fort Belvoir, Va., this first of a family of similar plants developed under the Joint Atomic Energy Commission-Department of Defense program became operational Apr. 15, 1957. It was built to acomplish R&D development tasks and to train plant operators.

Deactivation of the SM-1, announced by the Army Chief of Engineers, will coincide with the completion of training of the 13th Navy Crew for the PM-3A Nuclear Power Plant at McMurdo Sound, Antarctica.

The Army plans to continue its operator training activities at Fort Belvoir for the PM-3A and barge-mounted MH-1A, an Army Nuclear Power Plant currently located at Gatun Lake, Panama Canal Zone.

Classroom effort will be supplemented with training on the existing reactor simulator and fuel handling facility. In-plant training of operators for both the PM-3A and the MH-1A will be performed on the MH-1A subsequent to May 1973.

The SM-1 has been a tri-service training facility and has contributed to the training of a total of 813 supervisory and operator-maintenance personnel. A breakout of the training is as follows: Army 474, Navy 233, Air Force 101 and 5 civilians.

SM-1 trained personnel have manned the following military nuclear power reactors: Army, SM-1A (Fort Greely, Alaska); PM-2A (Camp Century, Greenland); MH-1A (Gatun Lake, Panama Canal); Navy, PM-3A (McMurdo Sound, Antarctica); Air Force, PM-1 (Sundance, Wyo.).

CONARC Announces New Textbook

The U.S. Continental Army Command (CONARC) has approved "Leadership and Exchange in Formal Organizations" by Owen Jacobs to be added to the CONARC Textbook List.

Produced under contract with the Human Resources Research Organization (HumRRO), copies will be printed by, and available from Department of Nonresident Instruction, The Infantry School, Fort Benning, Ga

The book has also been added to the Reserve Officers Training Corps (ROTC) Support Fund Book List, making it possible for professors of military science and tactics to purchase hardback copies for libraries and instructor use.

R&D NEWS . . .

Biodegradable Plates Show Fracture Repair Merit

Experimental biodegradable plates have exhibited important advantages over the conventional use of metal plates for fracture repair in animal research conducted by the U.S. Army Institute of Dental Research (USAIDR), Walter Reed Army Medical Center.

Biodegradable materials are made to degrade at different rates by using copolymers of polylactic acid (PLA) and polyglycolic acid (PGA). Copolymers give resorption times of from 50 days to 16 months, enabling the user to select a material that will degrade a predetermined time necessary for healing.

In the past, the use of metals for internal fixation led to the necessary removal of the material sometime in the post-healing period. Quite often removal of the metals may contribute to secondary infections.

In a study conducted at USAIDR, fractures were created in the mandibles of six dogs. Screws and bone plates of polylactic acid were used to fix the fractures in position. No appliance was rejected and, at 24 weeks, the plates could not be seen or palpated. Thirty-two to forty weeks after insertion, the area where the fracture plates were implaced was indistinguishable from the adjacent bony areas, and tissues had few inflammatory cells.

Results indicated that polylactic acid plates degrade slowly in dogs; no detrimental effects were observed, and the degradation did not interfere with osseous union and healing.

The material used in the treatment of osseous fractures by internal fixation must be sufficiently strong, compatible with the tissues, and must permit early osseous union. Experimentally to date, PLA has proved to be a biodegradable material that is tolerated well by the body tissues.

Research has shown that a device of sufficient strength can be fabricated to fix fractures of the mandible in adult dogs and can be inserted with the use of existing techniques and skills.

Biodegradable material has several obvious advantages over metals other than its degradability. It is possible to shape the appliance in the operating suite with blades, burs, or warm instruments. Placement of the holes in the biodegradable plates also can be determined at the time of operation. The surgeon thus has the opportunity to select ideal placement of both screws and the appliance. The device can be fused into a continuous one-piece system to give stability and immobilization of fragments.

The physical characteristics of PLA indicate possible use of this material in other procedures requiring long-term osseous fixation.

As yet, biodegradable plates and bone fixations have been used only in repairing animal fractures. However, PLA sutures are already replacing the conventional gut sutures in humans. Also, gut sutures may produce some inflammation because gut is composed of protein foreign to the body.

Research in the area of biodegradable materials has been conducted by the U.S. Army Medical Biochemical Research Laboratory at Forest Glen, Md., and by the Ethicon Co. under its privately funded program.

Controllable Feedhorn Improves Signals Over Alps

A method of aligning tropospheric scatter communications antennas has been invented by the chief of the evaluation team, U.S. Army Strategic Communications Command (STRATCOM)-Europe.

Julius F. Pezoli, the inventor, said the method stemmed from problems encountered in a 252-mile communications link in the Alps between Feldberg-Schwartzwald, Germany, and Savona, Italy.

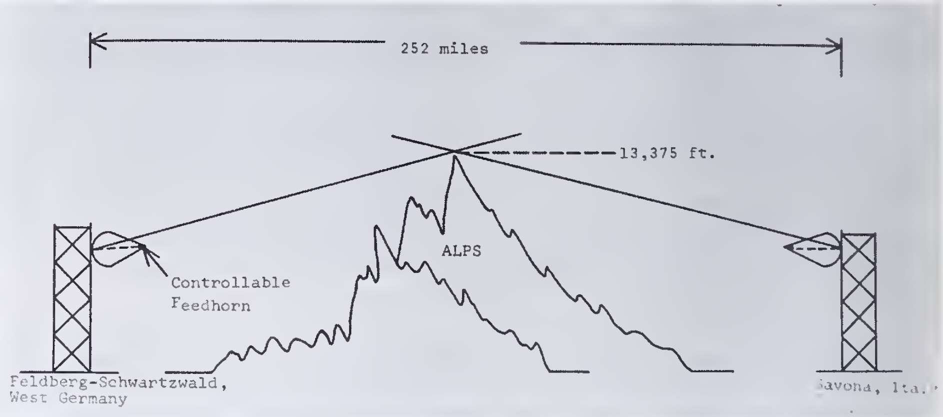
Antennas at communications stations in Germany and Italy are set for signals to intersect above a 13,375-foot peak, but variable cloud formations and weather conditions in the troposphere can bend the signal into the mountain side, blacking out communications. This condition has lasted for minutes, hours, and sometimes longer. The Feldberg and Savona stations were off the air for three consecutive days in 1966.

A representative of the National Bureau of Standards noted that the loss of communications might be avoided by moving the feedhorn so the signal angle could clear the mountain top.

Pezoli responded with plans for a controllable feedhorn, the device that aims the signal into the reflecting dish, which enables the station operator to realign the signal angle electronically to clear the mountain peaks. Initial tests have aroused the interest of the Defense Communications Agency.

Additional tests are being scheduled for representatives of the DCA, the Communications-Electronics Engineering and Installation Agency, and the Defense Communications Engineering Agency to determine if the invention will be used throughout the Defense Communications System.

CONTROLLABLE FEEDHORN inventor Julius F. Pezoli discusses the device with SSG John P. Spaulding who built the instrument. The drawing below illustrates the signal path for the Feldberg, Germany-Savona, Italy, communication link. Weather conditions and cloud formations can bend the radio signal into the mountainside and black out communications. With the feedhorn, an operator can realign the signal to clear the Alpine peak and restore communications.



National Materials Policy Seen as Target of NAS-NAE Study

Environmental issues bearing on formation of a U.S. policy for materials are being examined by a National Academy of Sciences-National Academy of Engineering study committee, in response to a request from the National Commission on Materials Policy (NCMP).

Consideration will be given to limitations on resource supply as a result of environmental policies; anticipation of environmental effects of selected materials from the point of exploration through the point of disposal and recycle; and international environmental agreements affecting availability of resources.

Materials to be studied consist of natural resources, excluding food but including energy materials, intended for use by industry for production of goods as defined in the commission's interpretation of its charge from Congress in the National Materials Policy Act.

The study group will function under the Committee on International Environmental Programs, a committee of the joint NAS-NAE Environmental Studies Board. The National Materials Policy Act authorizes the NCMP to make recommendations on the supply, use, recovery and disposal of materials in order to "enhance environmental quality and conserve materials."

Computer Assisted Instruction . . .

Army Signal School Proves Merit of CAI for Student Needs

Computer Assisted Instruction (CAI), a major area of human resources research effort in recent years, is an efficient and workable method of training students in basic electronics in comparison with conventional instruction (CI).

That is the announcement of BG Richard C. Horne III, CG of the U.S. Army Signal Center and School, Fort Monmouth, N.J., based on a 6-year intensive exploratory development effort.

Terming CAI a "significant step forward for future Army education"—as determined in response to a requirement of the Army Chief of Research and Development—BG Horne made his announcement simultaneously with issuance of a report titled "A Summary Evaluation of Computer Assisted Instruction in U.S. Army Basic Electronics Training."

An initial feasibility study was begun by the CAI Division of the Signal School in 1967 under the direction of the U.S. Continental Army Command as the first of its kind to be undertaken by any Army service school.

Used to accelerate training of electronic technicians, CAI can find the best learning path for each student's needs and aptitudes and gathers detailed data on his progress. The proctor has more free time for individualized attention to a student in need.

Conducted under experimental conditions, the pilot Signal School feasibility focused on the suitability of the CAI method in teaching increasing amounts of basic electronics material to students.

Dr. Vincent P. Cieri, former technical director, CAI, and present Signal School educational adviser, found that the group of students using CAI completed the prescribed training in 10.8 percent less time than the group of students using CI. The CAI students also showed equivalent achievement.

A follow-up study under *real* CAI classroom conditions showed that the CAI group of students completed the prescribed training in 20.1 percent less time than the CI group.

Results of the final study, encompassing the first four weeks of basic electronics training (102 hours), emphasize that CAI can reduce training time by 37 percent.

An analysis between the two methods of instruction included evidence on test achievement, time to complete course material, academic attrition, and favorable student attitudes towards CAI.

Plans are being made to develop a complete course for individualized instruction for a large-scale application of this programed computer training.

Under the direction of Frank E. Giunti, chief, CAI Division, a prototype CAI system is being programed at the Signal School using a multiprocessor minicomputer system.

Alexander Longo, research psychologist and author of the report, said "This prototype development and test offers the next big challenge for CAI in its continued evolution towards final applicability in Army training."

Picatinny Engineers Represent U.S. At Quadripartite Ordnance Conference

Robert Todd and Fred Fitzsimmons, engineering personnel at Picatinny Arsenal, Dover, N.J., represented the arsenal at the recent Quadripartite conference in London.

The conference, with ordnance personnel from the United States, United Kingdom, Canada, and Australia attending, dealt with such topics as proof inspection and quality assurance.

The aim of the meeting was to standardize test methodology and acceptance procedures on a wide spectrum of items, ranging from chemical powders and detonators to small arms and large-caliber ammunition systems.

WECOM Validates Need For New Automatic Weapon

Development of a new automatic cannon in the 20 to 30 millimeter range and delivery within nine months are specified in validation-phase contract awards announced recently by HQ U.S. Army Weapons Command, Rock Island, Ill.

Army project manager for vehicle rapid-fire weapon systems at WECOM, COL Robert W. Noce, said "there is a real need for a weapon of this versatility in the modern Army. During this validation phase of the contracts, the companies each will be turning out firing prototypes of their previously developed private concept guns and families of ammunition."

COL Noce explained that the system "will permit the gunner to select automatically the type of ammunition which will be most effective against the target being engaged and to start firing at it without delay. The ammunition for the weapon gives it increased range and lethality."

Called Bushmaster, the new weapon will be the successor to the Army's present interim 20mm gun weapon system. Selection of the contractor to proceed with further and final development will be based on an evaluation by WECOM and other Army agency engineers of the various prototype weapons.

Although system development will be handled by industry, extensive use of in-house laboratory management capabilities and support services of WECOM and Rock Island (Ill.) Arsenal are planned.

Competing contractors in the prototype phase are AAI Corp., General Electric Co., and Philco Ford Co.

MERDC Examines High-Power Battery Tester

Uniqueness is claimed for a new electric vehicle duty-cycle simulator undergoing acceptance tests for evaluating high-power experimental and prototype batteries at the U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.

Utilizing this station, candidate batteries for propulsion applications reportedly can be evaluated in less time, at less expense, and under more controlled conditions than with currently available methods. Military batteries, which may have deep discharges and irregular duty cycles, may have much shorter life and provide less total energy than batteries that have smaller discharges before being recharged.

The propulsion applications involve construction and materials-handling vehicles in the center's program of research, development, test, and engineering of electric-drive vehicles and components for the Army.

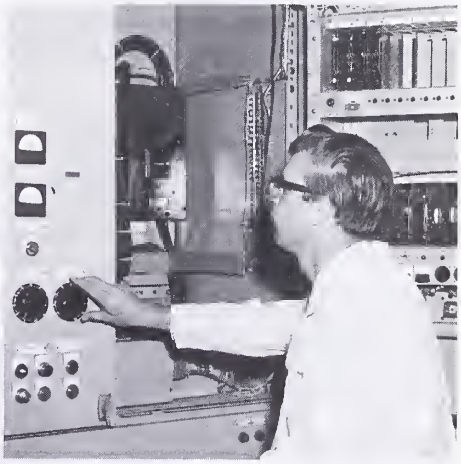
The station will be used to simulate the actual demand upon the battery from a vehicle as well as from the battery chargers. It is rated at 125 volts and 1000 amperes continuous, with short-duration overload capabilities.

Unique features include two voltage sources which can drive the station through its voltage and current ranges, using external controlling signals. The change from full charge to full discharge ratings is possible in a fraction of a second, with fast rise and fall times allowing simulation of actual field duty cycles. Conversion to higher voltages and currents also can be performed.

Two additional stations, a computer, and a data acquisition system are or will be in the over-all MERDC facility. Rated at 8 volts and 1800 amperes, the first of the other stations is extremely versatile and can control current, voltage, or power. Charge or discharge may be terminated by ampere-hour, watt-hour, or time endpoints as well as high or low voltage limits. Operation is either manual or computer controlled. Single cell characterization, new test procedures, and tests above 300 amperes are performed on it.

Under development is a station that will consist of at least three independent control sections with several different ratings to 40 volts and 300 amperes. Devoted to acceptance testing, preliminary checking of manufacturers specifications, and life cycle testing, it will control voltages, currents and resistances to time endpoints and high- or low-voltage limits.

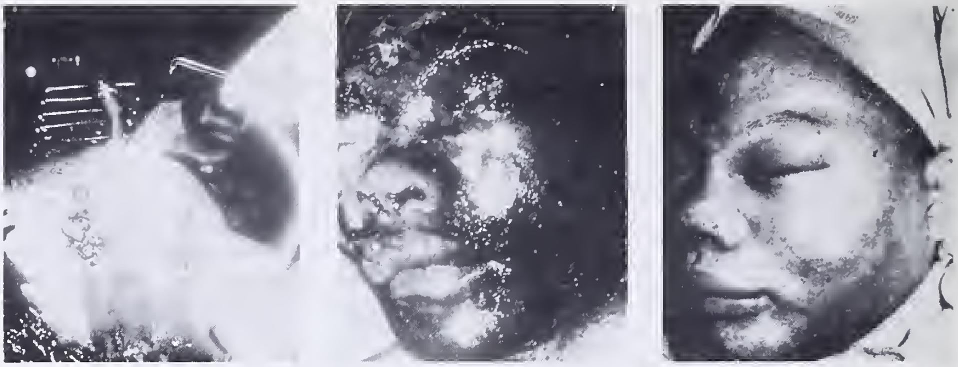
When complete, the facility will be capable of testing single cells and batteries from acceptance tests through complex duty cycles to extended life tests.



Edward J. Dowgiallo Jr. operates controls of battery test facilities at the U.S. Army Mobility Equipment R&D Center (MERDC), Fort Belvoir, Va. An employe of the MERDC Electrochemical Division, Dowgiallo wrote specifications and followed through procurement and testing of the station, considered one of the nation's most sophisticated of its kind.

Major Medical Advance . . .

Water-Jet Lavager Aids Severe Wound Treatment



WATER-JET LAVAGER shown (left) during actual use on patient. Photos at center and right show a burn blast victim seen immediately following injury and after one treatment.

Termed the "greatest medical advance in cleansing and treatment of severe wounds in the past century," the pulsating water-jet lavager (PWJ) has proved up to 50 times more effective than conventional methods when used with certain antibiotics.

Discussed by BG S. N. Bhaskar in one of the top award technical papers at the recent biennial U.S. Army Science Conference, the PWJ, developed at the U.S. Army Institute of Dental Research (USAIDR), Walter Reed Medical Center, was first used by the Army in 1967 to treat combat wounds in Vietnam.

Differing from conventional cleansing methods, the lavager utilizes an intermittent series of fluid pulses (1200 pulsations per minute) with 20–100 pounds of pressure per square inch. From 4 to 12 streams of water may be used to treat wounds of varying size, merely by changing discs in the delivery head.

The system removes bacteria and foreign debris much more effectively than a nonpulsating method—three times more effective in removing debris and seven times more effective in the removal of bacteria from an open wound. When used with certain antibiotics, it has produced much more rapid healing than conventional methods.

In addition to more effective removal of debris and bacteria, the lavager is capable of reaching areas of a wound site which previously had to be cleansed by use of a hard brush, causing extreme pain to the patient and requiring increased time for treatment.

A series of studies initiated in 1966 at the U.S. Army Institute of Dental Research (USAIDR) compared pulsating and nonpulsating water jets. The research was concentrated on optimal safe pressures, effects on normal tissues surrounding the wound, effects on bacteria and healing, and the effectiveness in the removal of debris.

Results established the superiority of the PWJ and it eventually was selected as an acceptable means of treatment of severely wounded patients in the Vietnam war.

The normal procedure utilizing the lavage method consists of cleansing the wound with a sponge and some type of cleansing solution. This is followed by the use of the lavager in combination with an antibiotic. The procedure may be repeated when necessary for the most severe wounds.

In one case report, a Vietnamese soldier, injured as the result of a burn blast wound, received hundreds of small foreign bodies composed of soil, gun powder, and metallic fragments over an extensive area of his face. Lacerations covered his nose, cheek, eyelid and upper lip.

Following treatment with the PWJ, these wounds showed no clinical signs of infection and healing occurred without complications. Ten days following treatment, satisfactory progress was reported.

CPT Wayne J. Selting, chief of the Department of Biomedical Engineering, USAIDR, explained that the pulsating jet water lavager is still undergoing improvements. Eight major Army hospitals are currently using the system in addition to several civilian medical centers.

BG S. N. Bhaskar, director of the U.S. Army Institute of Dental Research, was awarded $250 as a member of a 4-man USAIDR PWJ developmental team for his technical report, "Role of Water Jet Devices in Combat Surgery," at the Army Science Conference, June 20–23, at the U.S. Military Academy.

As a spin-off application of the lavage principle, a presurgical handscrubbing machine has been designed and patented by the Army. Termed "Hydroscrub," it lavages the hands and forearms with various types of solution delivered through 300 jets at pressures of 60 to 120 pounds per square inch.

The typical presurgical scrub requires up to 15 minutes, depending on the type and estimated time of an operation. The hydroscrub has reduced this time to 90 seconds.

The hydroscrub also has been found to be less irritating to tissue, more effective in reducing bacteria, and more effective in reaching certain areas of the hand such as the fingernails and surrounding skin.

Still considered an experimental device undergoing extensive testing, the hydroscrub has not been type classified as a clinical instrument. Two prototypes have been designed by the Army and additional research is being done commercially as interest grows.

New Process Cuts Time, Cost for Big Guns

Step threads on breech rings for giant 175mm guns and 8-inch howitzers can be machined in one-sixth the time formerly required, with corresponding cost savings, by using an improved method developed at Watervliet (N.Y.) Arsenal.

George A. Hutson designed the new machine specifically for the step threading process, which he also developed. Philip Casey assisted him by developing special cutting tools.

Chief advantage of step threading over normal threading for large gun breeches is the more effective thread contact achieved. This result provides the greater strength needed to absorb tremendous pressures during firing, plus a minimum of movement in the mating breechblock.

The standard step threading method employs an engine lathe that requires about 12 hours, compared to two hours for the improved process, and also constitutes a safety hazard. It tends to break tooling and work pieces and needs a highly skilled operator. Since January the new machine has produced 165 step-threaded breech rings with breakage of just one cutting tool.

Hutson has been cited for developing many other time- and money-saving machining processes for the arsenal, including improvements in trepanning, resistance welding, and a rapid tube-boring process.

George A. Hutson holds cutting tool used in this machine of his design, which has reduced the time required for step-threading a large breech ring from 12 to 2 hours. With him are Philip Casey (center), who developed the cutting tool, and Dominic J. Bisceglia, supervisor in Watervliet Advanced Engineering Division.

R &D NEWS

MERDC Studies Fan Without Moving Parts

As you swelter in the heat of summer, can you imagine a fan without moving parts and almost without sound?

A research program leading to the possible development of such a new device is being conducted by the U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.

Research is based on "ionic airflow," a term coined by the MERDC as a descriptive title for a phenomenon wherein air can be forced to flow by the electrical reaction between air molecules and an electrical field.

Believed to have first been discovered by Chattock in 1898 and called "electric wind," the phenomenon remained little more than a laboratory curiosity until serendipity recently entered the picture.

Working on another program involving the electric field, MERDC experimenters discovered that air could be forced to flow at a velocity well above 2,000 feet per minute, or more than twice the air velocity in the duct work of conventional heating or air conditioning systems. Further pursuit of this characteristic revealed that a static, or no flow, pressure could be produced.

Air contains ionized molecules of both positive and negative charge, which can be activated by a direct current electric field impressed across an air space between the ends of two conductors (poles). The air ions are accelerated to the electric field poles of opposite charge, but the velocity is dependent on the physical shape of the ends of the poles, the distance between poles, and the impressed voltage.

Because of the different ionic masses, electrical charges, and the difference in shapes of the two conductors, the result is a net ion flow from positive to negative.

Ionic airflow is generated by the kinetic and electrical charge energy of the accelerated ions, which collide with electrically neutral air molecules and propel them toward the conductor poles. As a result, the majority of the mass flow is electrically neutral.

Researchers are hopeful that experimentation will result in a device that would have no moving parts, such as electric motors, fans, or bearings, and with almost no sound, but otherwise would have the airmoving characteristics of the conventional fan.

MSA to Simplify Terminology Classifications For Improvement of Communications Process

The Medical Service Agency (MSA), U.S. Army Combat Developments Command (CDC) is attempting to clarify the terminology used by people doing work with the Army Medical Department—like CDC itself which identifies and anticipates the present and future combat needs of the Army, including medical support.

"This study won't deal with the physician's professional jargon," said a CDC spokesman. "It will, however, improve communications between groups who must work on medical plans and problems."

Despite service school efforts, the CDC notes, all members of the same arm or service do not have identical definitions or understandings of terms. Thus the study is expected to develop new terms and definitions and clarify or eliminate confusing ones.

In addition, the study by CDC medical experts at Brooke Army Hospital, Fort Sam Houston, Tex., is expected to simplify medical literature and standardize instructional material.

SATCOM Completes Task Given High AF Priority

Project SHAG has been completed on schedule by the Army Satellite Communications Agency (SATCOM) as a high-priority engineering project for the Air Force.

The Department of the Army last December assigned the SATCOM Agency the task of equipping selected satellite communications earth terminals to provide the Air Force with a high-capacity, digital data transmission system. The project involved three Navy terminals—one on Guam, two in Hawaii—and an Army fixed-station terminal at Camp Roberts, Calif.

SATCOM Agency engineers explained that the job called for the fabrication, installation, testing and checkout of one additional frequency conversion chain for each of the Navy terminals and modification of their high-power transmitters.

Two additional frequency conversion chains were to be fabricated, installed, tested and checked out at the Camp Roberts site. When it became apparent the completion date could not be met by contracting out the work, it was decided to design and fabricate the necessary equipment in-house at the SATCOM Agency.

The Agency had available link terminal simulation equipment which had been delivered for an earlier project, including parts that could be recovered and used with new equipment to provide the needed conversion chains. The required hardware was assembled, installed and tests were conducted at the various terminal sites.

The SATCOM Agency is the Army project manager organization for satellite communications. Military satellite communications are a joint-service undertaking of the Department of Defense. The Army is responsible for the development of earth terminals, the Air force for the design and launching of satellites, and the Navy for the development of shipboard terminals.

Navajo Depot Boasts Prideful Munitions History

One year after the Japanese attack on Pearl Harbor plunged America into World War II—when "Pass the ammunition" had become a musical rallying cry—the Navajo Army Depot (now Navajo Depot Activity), made its first shipment of war supplies to the combat zones.

Since 1942, this installation near Flagstaff, Ariz., has "passed the ammunition" to American soldiers in two additional major conflicts—the Korean War followed by the long struggle to keep South Vietnam free.

Taking its name from the nearby Navajo Indian Reservation, the depot houses ammunition in 801 igloos and 12 standard above-ground magazines. A general supply or "combat" warehouse area includes 16 buildings with more than 1.5 million feet of storage space. An extensive array of supporting maintenance shop facilities is in standby.

Following the Korean War, the depot workload and personnel decreased until the Vietnam conflict began. During this period, however, the depot provided support services to various government agencies, including the U.S. Naval Observatory and the U.S. Astrogeological Survey. It was also used as a base for weather studies.

In 1964 the depot furnished support for 10,000 troops in Exercise DESERT STRIKE, one of the largest held in the United States.

Because of its isolated location, cold weather, heavy snow and rocky terrain, skilled labor was difficult to get and keep during early construction of the depot. The Navajo Indian Reservation furnished a large supply of unskilled labor, but the Army ran headlong into a language barrier. Very few Navajos spoke English.

To keep them from returning to the reservation, depot officials built the first Navajo "town" on record. A trading post was established, sheep brought in, looms furnished the women for their weaving, and Navajo interpreters were hired.

Another historical sidelight centers around the depot's administrative area, once the home of a pioneer sheep rancher in the 1830s when this part of the country was known as the Arizona Territory. The rancher's source of water was the same group of springs that now provides water for the depot, producing some 90,000 gallons a day.

During its peak, the depot had as many as 2,000 civilian employes and 40 military personnel. Today, the complement consists of 110 civilians and three military personnel.

The Navajo Depot Activity is operating with a greatly reduced work force, but as an Army Materiel Command (AMC) facility it continues to serve an important mission.

MACHINE OPERATORS at work in machine shop at Navajo Depot Activity.

HEDP Dual-Purpose Cartridge:

Picatinny Arsenal Claims Amazing Destructive Power for Grenade Designed for Individual Soldier to Serve Numerous Combat Needs

By Wallace J. Harvey

HEDP splinters 4-inch logs into toothpicks, shatters concrete blocks into dust, tears through reinforced concrete and brick, demolishes sand bag emplacements, and perforates two inches of steel armor plate with ease.

Sound like a 105mm tank or artillery projectile? No, this munition item is shoulder-fired by a soldier using the 6½ pound, M79 hand-held grenade launcher.

This high-explosive, dual-purpose 40mm round was created by joint effort of the project manager for Selected Ammunition and the Warheads and Special Projects Labs at Picatinny Arsenal, Dover, N.J.

In technical terms, it's known as the M433 HEDP cartridge and shares honors with the combat-proven M406 round, another joint SA-PA accomplishment.

Besides giving the combat soldier the same antipersonnel capability as the M406 round, the new ammo gives him the added ability to engage and destroy enemy materiel, including lightly armored vehicles such as personnel carriers, self-propelled weapons and amphibious vehicles.

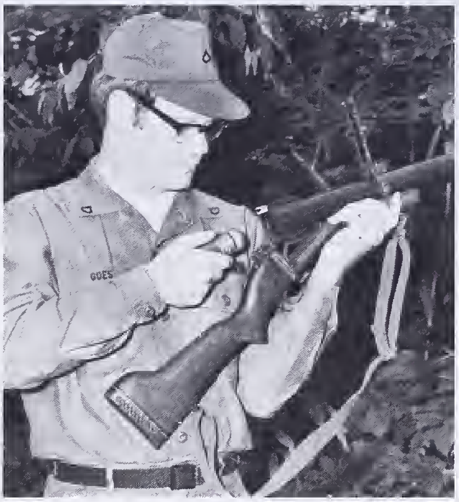
The impact this round will have on infantry field operations remains to be determined by its performance in combat situations. But its potential, as seen in field tests to date, appears to be substantial.

Supply dumps, ammunition, fuel oil and gasoline storage areas are "sitting ducks" for the destructive force of this fist-sized grenade. Its antipersonnel effectiveness is achieved by spreading hundreds of small, high-velocity, lethal fragments throughout the target area.

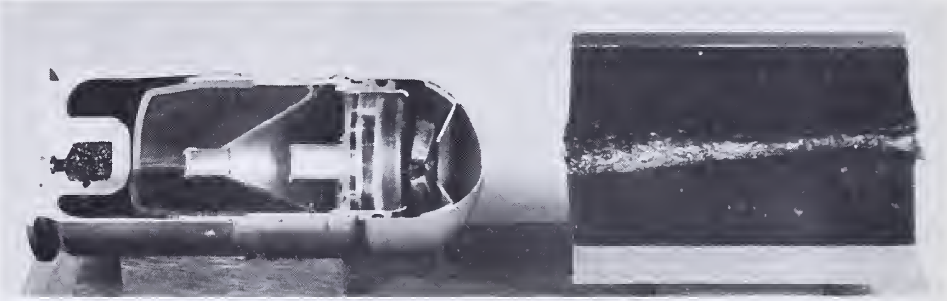
In this respect, its effectiveness is equal to that of the M406, the standard round for the M79 launcher, and the M203 launcher attachment for rifles.

How many other applications of this round may be developed for a combat situation is not yet known, but the imagination of the American GI is certain to put it to full use in combat.

Penetrates Armor. In tests conducted by the U.S. Army Infantry Board at Fort Benning, Ga., the M433 was fired at the M59 steel armor-plated personnel carrier. On frontal impacts, the round completely perforated the armor, showering the cockpit with spalled fragments. In another instance, the engine transmission was hit, cracking the case and igniting the residual oil inside.



MORE FIREPOWER is available to the U.S. Army infantryman using the new M433 dual-purpose 40mm round developed by the U.S. Army Munitions Command at Picatinny Arsenal, Dover, N.J. Fired from the M79 grenade launcher, the "pint-size" round easily penetrates two inches of armor plate. It can break up fortifications of logs, earth or sandbags.



CAUSE & EFFECT are seen in this photo of the M433 40mm round and the 3-inch piece of rolled homogenous steel it completely penetrated during Picatinny Arsenal test.

On side impacts, the troop compartment was perforated and showered with fragments spalled from the steel armor-plated side walls. Fragments penetrated plywood witness panels strategically located within the troop-carrying compartment.

Targets simulating hasty fortifications constructed of logs 4 to 12 inches in diameter were erected. The 4- to 6-inch log walls were snapped in two and shredded like toothpicks; fireballs encompassed the fortification from residual sap in the freshly cut timber. Even the 10- and 12-inch logs were perforated, sending large splinters in all directions.

In other tests involving vehicle fuels, 5-gallon cans of gasoline, placed behind one-inch steel armor-plate to simulate storage conditions, were destroyed. Violent flames engulfed the area.

Penetration tests also were conducted at Aberdeen (Md.) Proving Ground. During the final engineering evaluation, the cartridge was fired against a 2-inch thickness of homogeneous steel armor plate set perpendicular to the flight of the projectile, and against a one-inch-thick armor plate sloped 60° from the flight path. In both instances, complete perforation was achieved.

Army Sets Requirement. In the early 1960s the requirement for a dual-purpose (antipersonnel, antimateriel) cartridge for the M79 grenade launcher was set up by the Department of the Army. Its primary role was to inflict personnel casualties; its intended secondary role was to defeat lightly armored vehicles. A third consideration was that the new round be ballistically matched to the standard ammunition for the M79 grenade launcher.

Picatinny Arsenal, the Army Munitions Command's R&D Center for conventional artillery, armor and mortar munitions, was given the go-ahead for a design study. Experimental rounds were produced and test-fired, and a paper design for a fuze was established.

Engineers concluded that within the confines of ballistically matching the dual purpose round to the M406, the antipersonnel lethality would not be equivalent to the M406 cartridge.

However, it was felt that a dual-purpose round, whose basic function was to penetrate two inches of steel

THE AUTHOR, Wallace J. Harvey, is a project engineer with the Warhead & Special Projects Laboratory at Picatinny Arsenal, Dover, N.J. He has been employed at the arsenal for the past 20 years. Since 1956, he has been directly responsible for research and development of 40mm ammunition for hand-held launchers, which includes development of M406, M407, M583, M585 and M433 cartridges.

armor plate, could provide a bonus effect in the antipersonnel area—by increasing the probability of added lethality against personnel abandoning or being in the vicinity of an armored vehicle under attack.

Additional defined performance characteristics required that:

- The round have maximum range of at least 400 meters.
- Using aimed fire, its accuracy at all useable ranges be equal to that of the standard HE round.
- Using aimed fire, and when employed against vertical targets, its accuracy at all useable ranges up to 150 meters be such that 90 percent of all rounds fired impact within an area 6 feet high by 6 feet wide.
- It be able to penetrate at least two inches of homogeneous rolled steel armor plate at 0° obliquity and at least one inch of pentration in steel sloped at 60° from the vertical.
- When used against personnel, its lethality be at least equal to that of the M406 round.
- It match the M406 in external configuration and weight, and ballistically match the M406 without requiring new or supplementary sights on the grenade launcher.

In July 1968, hardware of the final design was delivered to Aberdeen Proving Ground and to the U.S. Army Infantry Board at Fort Benning for final engineering and service tests. By September 1969, all tests were completed.

Results showed that the M433 dual-purpose round not only met, but exceeded, the desired effectiveness requirements. In December 1970, the round was type-classified as adopted type Standard A, and added to the Army's family of small arms ammunition.

Field Availability. The 8.1-ounce cartridge will soon be available to field units and is ready for use as issued. The round is ballistically matched to the standard M406 round at all ranges out to 400 meters, eliminating the need for separate sights or sight adjustments on the M79 Launcher.

This matching gives the infantryman a significant combat advantage. For example, commonality of the M433 cartridge case and propulsion system with the standard M406 round and equal weights of the projectiles, insure the same recoil forces.

One of the safety features of this round is its delayed arming device, which does not activate the fuze until the round has traveled at least 45 feet from the muzzle of the launcher. This protects the soldier against premature functioning, in the event the projectile strikes an object in its flight path at less than 45 feet.

The ultimate safety of this round is assured by the fact that the arming action is dependent on two distinct and independent forces—set-back and spin. They must occur in the proper sequence to arm the fuze.

Upon impact, hammerweights drive the firing pin into the detonator by crush-up or inertial forces which, in turn, initiate a spit-back, high-explosive booster charge. Acting essentially as a miniature shaped charge, the booster produces a jet of hot gases and molten particules of the aluminum liner which "spits back" and detonates the RDX high-explosive base charge.

Detonation of the RDX explosive produces an armor-piercing jet of hot gases and molten copper liner traveling at a velocity approaching 10,000 meters-per-second as it penetrates the target.

Upon impact, the steel wall of the projectile is broken up into hundreds of small, uniformly shaped fragments traveling radially outward at high velocity, providing antipersonnel effects in the vicinity.

The M433 cartridge is currently scheduled for full-scale production at the completion of the advanced production engineering program, which is oriented toward providing a mass-producible round at the lowest feasible unit cost. It is expected to be in the Army inventory within the FY 73–74 time frame.

Indications of the cost are favorable. Because of the similarity of the M433 cartridge to the M406 HE cartridge, unit costs of the two rounds should be comparable.

The fact that the antipersonnel effectiveness of the dual purpose round is essentially equal to that of the M406, while providing additional antimateriel capability, should assure favorable acceptance by the combat soldier.

MG E. M. Graham Jr., commanding general of the U.S. Army Munitions Command, indicates that this new capability could have far-reaching effects on the battlefields of the future. The preponderance of armored personnel carriers will be vulnerable to a munition available to every grenadier in the infantry squad.

Land Warfare Laboratory Marks 10th Anniversary

Marking its 10th Anniversary, the U.S. Army Land Warfare Laboratory (LWL), Aberdeen (Md.) Proving Ground, recently paused to memorialize a former staff officer killed in the crash of an Army helicopter Mar. 17, 1970, in Vietnam.

Army Chief of R&D LTG William C. Gribble Jr. dedicated the renaming of Building 360 to Thomas Hall, in honor of LTC Robert J. Thomas who served as a liaison officer between his office and the LWL from September 1967 to February 1970. Mrs. Thomas unveiled a bronze plaque renaming the building for her late husband. His parents, Mr. and Mrs. N. J. Thomas, Anaconda, Mont., attended the ceremony. A framed portrait of the deceased was presented to the LWL by his U.S. Military Academy Classmates (1953) stationed in the Washington, D.C., area.

Established June 15, 1962 as a Class II activity under the direction of the CRD, LWL was formerly known as the Limited War Laboratory. Over the years its mission has been expanded from a quick reaction capability, as related to limited war requirements, to that of providing a centralized research and development facility for specialized military items in support of the Army worldwide.

During 1963, the LWL established liaison with the Army Concept Team in Vietnam (ACTIV) (see *Army R&D Newsmagazine,* March-April 1972 issue). Under this arrangement, a liaison officer—alternately a civilian engineer and a military officer—is sent to Vietnam on a 90-day rotational basis.

Twenty-six items had been sent to Vietnam by 1965 for evaluation as rapid-response solutions to special problems. Among them were a smoke dispenser, an aircraft personnel lowering device for rescue or medical treatment operations, and an aircraft free-drop water container. The LWL's source of pride is that during a decade no item has taken longer than 18 months to develop.

The LWL had developed new ideas for materiel and upgraded technology, concentrating on improving the individual soldier's effectiveness. The growing list of successful developments includes the SM-21 sniper rifle with a variable range telescope, a lightweight automatic individual flotation device, riot control patrol vehicle, a smoke marker for aerial rescue or supply delivery, a helicopter navigation system (HELNAVS), a water analysis and filtration device, a family of mini-smoke and pyrotechnic grenades, and the well-known "people sniffer" (personnel detector) used in Vietnam.

The name changed from Limited War Laboratory to Land Warfare Laboratory in 1970, retaining the LWL initials that had been a source of pride for eight years. The change in mission enables the laboratory to support the Army on a worldwide basis.

The Land Warfare Laboratory, currently commanded by COL Richard L. Clarkson, has grown to include 15 military and 126 civilian personnel, working in two main buildings. Liaison arrangements of the LWL have been expanded to include regular visits to Korea, Thailand, Alaska and Europe. A permanent liaison officer also is a Project MASSTER (Modern Army Selected Systems Test, Evaluation and Review organization), Fort Hood, Tex.

Increasingly, the laboratory is being asked to develop quick solutions to problems relating to mid-intensity warfare—such as night-flying in helicopters at tree-top level—while pursuing efforts to improve the soldier's lot in many types of environment.

Making full use of its multidisciplinary experience, LWL continues to stress imaginative and innovative solutions to current and envisioned Army materiel problem areas, to provide maximum combat capability in any environment.

'A Decade of Vision & Progress'

CDC Marks 10th Anniversary, Notes Contributions of Leaders

Mission objectives, policies and methodology of the U.S. Army Combat Developments Command, Fort Belvoir, Va., have been prescribed by six hard-driving commanders since its establishment in the 1962 Army-wide reorganization.

Each is credited with contributing notably to "A Decade of Vision and Progress" as recently commemorated by the CDC. LTG John P. Daley, who died a year after he became the first CDC commander, is remembered for setting the command on course and moving it rapidly toward the early goals.

"CDC's task," GEN Daley said, "is to find answers to three questions: How should the Army be equipped? How should the Army be organized? How should the Army fight?" His staff was continually reminded of this task.

LTG Dwight E. Beach, who served under LTG Arthur G. Trudeau as his deputy, and succeeded him a year later as Army Chief of Research and Development in June 1962, was the second CG of the CDC from August 1963 to May 1965.

One of the significant policy and problem assessments for which GEN Beach is remembered was: "The need to keep doctrine and technology in balance is at the heart of the CDC mission. In the coming years, we can expect the scope and complexity of that mission to increase as scientific advances continue." CDC's responsibilities have expanded with this growth.

LTG Ben Harrell led the CDC from May 1965 to June 1967, outlining CDC's functions for land combat as "firepower, mobility, command and control, intelligence and support." He also initiated the Life Cycle Management Model and began to exploit the computer to aid restructuring of logistics.

LTG Harry Kinnard, commander from July 1967 to August 1969, brought to his duties the experience of developing the 11th Air Assault Division and serving later as deputy assistant CofS for Force Development. He stressed responsiveness to critical Army needs and established the Doctrinal Study Program to stimulate creative effort and innovations in doctrine.

LTG George Forsythe, who until his retirement, directed the Modern Volunteer Army Program, succeeded LTG Kinnard, serving as CG of the CDC until October 1970. Providing strong guidance to both long- and short-range planning as an aid to the Department of the Army planning and programing cycle, he stressed "professionalism" in developments to meet needs of the combat soldier.

LTG John Norton, who has headed the

CDC Mission as 'User's Representative' Viewed As Giving Combat Soldier Improved Capability

By a CDC Staff Member

Giving the combat soldier a lift—getting him off his tired feet by rapid mobility methods—has been the name of the game for the Army's Combat Developments Command (CDC) since it was born almost concurrently with formation of the Howze Board in 1962.

This was the Army's first really hard look at its tactical mobility concepts—or how to deliver a highly trained soldier to the battlefield in the best condition to put up a real winning fight. The best answer so far has been the helicopter.

Evaluating the findings of the Howze Board (named for GEN Hamilton Howze, now retired) was CDC's first task. Realistically, it might be termed *continuing* task because for the past decade CDC has been the Army's center for airmobility thinking.

Responding to the compelling potential of the helicopter, CDC's "brain bin" wrote the battery of tests which proofed-out the Air Assault Division concept. The result became the famous 1st Cavalry Division, and perhaps others like it, because CDC and the 1st Cav are still busy refining the airmobile principle.

The test vehicle this time is the unique TRICAP (Triple capability) force at Fort Hood, Tex. There the major part of the 1st Cav is deployed in various "mixes" of Air Cavalry, Airmobile Infantry, Armor units, and attack helicopters before the hard eyes of the data collectors.

CDC is now evaluating the first phase of TRICAP testing.

But the soldier, and the Army, had many other problems and needs for CDC to attack during the past 10 years. In fact, that's the heart of the CDC mission: identifying what the soldier needs to increase his combat effectiveness—the *true* needs, that is, not the hazy, imagined ones. This does not always make CDC popular with the people who have "a great idea the Army's just *got* to adopt."

In playing its role as (it was once called) "The Army's Idea Proving-ground," CDC focuses on helping the soldier see, move, shoot and communicate on the modern battlefield. This can involve a complex airborne system or a simple, belt-worn device. Both must pass the same test: Does the soldier *need* it to fight better? Is it worth the price—and the weight?

This last, the weight pressed on our soldier, is where CDC plays a vital role as "The User's Representative." The problem of the actual, animal weight on the soldier is attacked from many sides. One approach uses the help of the soldier himself, through CDC's Sounding Board for the Individual Soldier run by CDC Infantry Agency at Fort Benning, Ga. This program invites his comments, informally and directly, on the weight, size, color or performance of any item of individual equipment he uses.

Not only the weight on his back, hips and head, but the weight of noise on his ear drums, fumes in his eyes and vapors in his lungs as he uses new equipment, gets CDC's constant attention. Can the soldier *live* with the system on the battlefield—and vice versa? Can the average soldier get the capabilities out of the system that have been designed *into* it?

CDC leaders look at combat effectiveness in two dimensions: from the viewpoint of a total land combat system and that of the individual combat soldier. Both the system and the soldier are composed of many complex details and subsystems. The late LTG John P. Daley, first commander of CDC in 1962, said "It takes 18 years lead-time to make an American soldier."

Thus while part of CDC is absorbed in intricate battlefield surveillance systems, SAM (surface-to-air) missile defense and weapons systems, other people in CDC remain undistracted by them, even unimpressed. That's because *their* part of the task is to keep these complex and costly systems "human-oriented" —within the capabilities of the soldiers who must someday use them in a hostile environment. This is the "human factors engineering," which the CDC has made mandatory, not just fashionable.

Even in challenging areas of development like Force Design, the CDC keeps soldier-oriented as it looks into the many "mixers" that could comprise our future divisions. That they will be smaller is likely. But how much punch they'll have depends on how our modern technology and our modern professional soldier are "married-up," through CDC's relentless studies and experiments.

Mobility, firepower, communications, combat support and logistics are more than combat-oriented *systems* to CDC. They are the tools the soldier will use *after* it's determined *how he will fight,* and who fights *beside* him.

Recommending the correct tactics for deploying the correct organizations, correctly armed and equipped to win battles, is a broad way to describe CDC's first decade's work. Providing our nation with a correctly armed, trained and led professional soldier who can win his share of the battle is a simpler way to describe it.

That's the message from CDC's first 10 years: the design for an effective Army starts with the USER—The Soldier.

And how to do it? The way CDC's been doing it: anticipate and innovate.

Engineers Establish New District For Hurricane Reconstruction Work

Establishment of the Susquehanna Engineer District in Harrisburg, Pa., by the U.S. Army Corps of Engineers, is directed to recovery and reconstruction work in the Susquehanna River Basin hard hit recently by Hurricane Agnes. COL John Francis McElhenny heads the district.

All emergency duties previously performed by the nine temporary area offices of the corps' Baltimore and New York districts will be assumed by the new district. These duties will include debris removal, reconstruction of public buildings, water supply and sewage facilities, repair of flood control structures and preparation of mobile home sites currently providing temporary housing for flood victims.

CDC since October 1970, was chosen for the assignment after serving as deputy director of Project MASSTER (Modern Army Selected System Test and Evaluation Review) at Fort Hood, Tex. Under his leadership, the authority of CDC "middle managers" (group commanders) has been strengthened.

LTG Norton has repeatedly emphasized the requirement for investigating thoroughly the force design alternatives which can provide the basis for force planning and budgetary decisions. In stressing acceleration of CDC mission objectives, he has stated: "Our nation needs a smaller, sharper Army—and the sooner we get there, the better!"

The CDC's 10th anniversary celebration was highlighted by an address by Under Secretary of the Army Kenneth E. BeLieu, who termed it "the thinking command . . . for building new concepts out of available resources and technology. It has tested and sifted to be sure the benefits outweigh the burdens."

Another feature was the innovation of CDC annual awards, presented as follows: MG Casey Award to LTC Albert C. Malone, CDC Infantry Agency, Fort Benning, Ga.; LTG Daley Award to MAJ Richard H. Girouard, CDC Intelligence and Control Systems Group, Fort Belvoir; LTG McNair Award to MAJ Douglas K. Lehmann, CDC Organization Directorate, Fort Belvoir; GEN Somervell Award to MAJ John C. Carlin, Special Operations Agency, Fort Bragg, N.C.; Commanding General's Award for "Improvement in the Development Process" to MAJ Edward G. Preston, CDC Experimentation Command, Fort Ord, Calif.; Soldier's Award for "Improvement in the Effectiveness and Welfare of the Individual Soldier" to CDC Command SGM Lawrence E. Kennedy, Fort Belvoir.

CDC's planning efforts are headquartered at Fort Belvoir but extend through a broad diversity of activities at widely divergent locations. Much of the current effort to prove the feasibility of doctrinal concepts, organization, and mixes of manpower, materiel and equipment is centered on the TRICAP (Triple Capability) Division and the Air Cavalry Combat Brigade at Fort Hood, Tex.

"CDC's Live Chessboard" is the term often applied to the "outdoor laboratories" of the CDC Experimentation Command at Fort Ord, Calif., where 68,000 acres provide the setting for testing.

The CDC basic policy requires exhaustive testing of materiel before it goes to users. War games are fought with simulated battlefields and computers to test the strengths and weaknesses of alternatives or organization, weapons systems and battlefield tactics.

Cited in a recent CDC Decade of Vision and Progress publication as examples of CDC's wide-ranging area of interest in materiel and equipment during the first 10 years are the M107 175mm SP (Special Purpose) weapon, the M109A1 gun which entered the inventory in 1972, the M102 105mm towed howitzer, the M110 8-inch howitzer, and the M109 howitzer.

Mentioned also is the CDC role in producing requirements for three major aircraft systems: the AH-56, the UTTAS (Utility, Tactical Transport Aircraft System), and the HLH (heavy-lift helicopter). Other items listed include the M132 mechanized flamethrower, M202 flame rocket launcher the automatic chemical agent alarm system, the TOW missile system, night-vision devices, the new combat zone hospital (TOE 8–123H), and various other combat soldier requirements.

In commenting on "A Decade of Vision and Progress," LTG Norton said the command "has been a key force in all the major innovations of the past 10 years, including the airmobile division, the armed helicopter, the integrated battlefield control system, and other major improvements in firepower, air defense, intelligence, logistics, and personal support systems. . . ."

IHD Plans Hydrological Symposium To Examine Ice-Snow Developments

An interdisciplinary Symposium on Advanced Concepts and Techniques in the Study of Snow and Ice Resources is being planned by the U.S. National Committee for the International Hydrological Decade (IHD).

The symposium is scheduled for late November 1973 at Southshore Lake Tahoe, Nev., and persons desiring to present technical papers must submit abstracts as a basis for selection by Oct. 1, 1972.

Despite a variety of large-scale studies of snow and ice dynamics and sea-air interactions affecting the global circulation of oceans and atmosphere, the committee believes that developments in snow and ice hydrology "have not kept pace with those in other branches of the hydrological sciences."

Problems to be examined at the symposium include natural processes, observational systems, modeling and computational techniques, and management of snow and ice resources.

Abstracts of proposed papers should be sent to: Executive Secretary, U.S. National Committee for the IHD, National Academy of Sciences, 2101 Constitution Ave., Washington, D.C. 20418.

MERDC Designs New Airfield Runway Lighting System

By A. E. Gates
Project Engineer
RD&E Directorate
Mobility Equipment R&D Command

A portable airfield runway lighting system for use on military, government, or private airports consists basically of equipment that provides a standard pattern of lights outlining the runway. Positioned to indicate clearly runway side and end limits, the lights enable pilots to make safe landings and take-offs at night or under restricted daytime visibility.

The popular approach to airport runway lighting uses incandescent lamps spaced at equal intervals along each side, with optional use of lights along the ends of the runway. Series-circuit systems used are very similar to the extensively used standard series-circuit street-lighting systems.

Both systems use a variable-voltage constant-current transformer to supply current to the lamps. For the runway system, the transformer is provided with a brightness control switch for supplying five levels of lamp brightness from 3.8 to 6.6 amperes. Each lamp is designed to carry a maximum current of 6.6 amperes at 4.5 volts.

A power isolation transformer is connected to each runway marker light to keep the series circuit closed when a lamp in one of the marker lights burns out or its filament is broken. The isolation transformer, therefore, serves as a bypass device to prevent burnout of a lamp from deactivating the lighting system.

In the late 1950s, using the series-circuit constant-current approach to runway lighting, the Army proposed a portable runway lighting set to provide sufficient light for a runway 2,000 feet long by 200 feet wide.

Still extensively employed in combat and noncombat areas, the set includes 22 runway lights (plus 8 optional end-of-runway lights), a regulator, engine-generator, and aircraft traffic light. A companion lighting set supplements this set when used in noncombat areas. Each marker light is fed from the power cable through an individual 30- to 45-watt power isolation transformer.

A modification of the present Army runway set has recently been designed, developed, tested and evaluated by the Army. It is designed to operate without the 30/45 watt transformers under either combat or noncombat conditions. Each transformer has been replaced with a small, lightweight and inexpensive electronic bypass device installed in each marker light and connected in parallel.

The electronic bypass device acts as an automatic OFF-ON switch that remains open when the lamp is operating but closes immediately when the lamp filament is broken. Also, it will immediately and automatically switch from on ON position to an OFF position when the damaged lamp is replaced The turn-on time is only a few microseconds and the turn-off time is much less than a second. The electronic bypass device has all the inherent advantages of a solid-state device, including long life and ruggedness.

The improved light set was designed, developed and tested at the United States Army Mobility Equipment Research and Development Center (USAMERDC), Fort Belvoir, Va. It passed preliminary operational, endurance and temperature tests, equalling or outperforming the present light set.

Field (troop) and reliability tests are scheduled to determine the mean-time-between-failure (MTBF) of the improved light set and transformer replacement device.

A cost reduction is offered with the improved light set over the present set without sacrificing performance. Part of the cost reduction is accomplished by (1) eliminating the 30/45 watt power isolation transformers and replacing them with the less expensive electronic circuits and (2) eliminating the two transformer chests supplied with each set.

The *hardware* cost of each electronic bypass circuit is approximately $4.00 as compared to about $48.00 formerly. A Value Engineering Review is being conducted to determine the cost reduction.

Commercial and other military airfield lighting equipment that is similar or equal to that required for installation at Army airfields can benefit from the Army's development. For every airport runway, taxiway, and obstruction light that uses a power isolation transformer, there is the possibility that this transformer can be easily replaced with a very simple and inexpensive bypass device.

SPEAKING ON . . .

(Continued from inside front cover)

projects, and North Africa for the past 2,000 years has been an impoverished desert region.

Today, in southern California, another rich and thriving civilization exists in an arid region through very large-scale water-resource developments. If the people who want to stop California's water resource developments were to succeed, I don't think they would really improve the environment of California any more than the Romans improved the environment of North Africa, or the Mongols the environment of Mesopotamia.

The 70-odd years of this century have been the years of most of our industrialization with its consequent impact, good or bad, on the environment. Have these 70 years really been destructive?

When Theodore Roosevelt became President in 1901, about four-fifths of America's primeval forests had been leveled. Soil fertility was becoming exhausted in some areas. In others, prairie soil had been exposed to wind and rain erosion. An estimated one-third of the world bird population had been destroyed.

Some native wildlife species had been exterminated; others, like the buffalo, beaver and seal, were endangered. Many rivers were in far worse shape than they are today. Sewage, sanitation, and disease control were major problems. Accumulations of the manure in city streets and alleys were subjects of outcry and alarm.

Theodore Roosevelt and his associates launched a conservation movement based on the principle of *wise use* of resources, with emphasis on both words. Within seven years, more than 234 million acres had been reserved for conservation purposes. Five national parks, 51 bird and four game refuges were established.

Since this is the centennial of the National Park System, I might add that the Army and the Corps of Engineers played a key role in the foundation of the national park system. The bison herds were saved—the biggest ones are at an Army Engineer project up in Montana. Deserts were changed into fertile farmland.

The Antiquities Act authorized preservation of cultural and historical landmarks. The Army Engineers have played a major role in this endeavor, too. The first inventory of natural resources ever undertaken by any nation was launched, again with the Army Engineers playing a key part. Within a few years, 41 States had created their own conservation programs.

That is the record of just the first seven years of the conservation movement. To the best of my knowledge, nobody has catalogued the gains of the other 63 years. I wish someone would add them up for us! I wish some of the people who are so vigilant at jotting down the environmental losses of our era would turn their energies to cataloguing its environmental gains as well.

The gains must be tremendous, for they embrace the ardent efforts of three-quarters of a century of devoted conservation work at all levels of community life—federal, state, and local communities; Boy Scouts and Campfire Girls and many other conservation organizations; universities and their research; agencies like the Soil Conservation Service and Tennessee Valley Authority. All have made enormous aggregate contributions to wise resource management and use.

As a result, today we have more and bigger and better-managed forests than we had at the turn of the century, and in addition have developed the whole science of forestry. We have more game preserves. Endangered species have been rescued.

Soil and watershed and grassland management programs exist across the nation. Scores of valleys and hundreds of communities have been protected from flood, drought, and the loss of sustenance. We have hundreds more lakes, and have them in regions where lakes were unknown before.

In this country, by contrast with others, the great majority of natural wonder spots and historic shrines are owned by and managed for the public.

We have all these things, and at the same time we have multiplied our productivity many times. Our standard of living has become the highest ever known to any nation. We are sustaining whole populations of less fortunate people overseas.

How blind we would be to ignore enormous achievements like these! How bitter must be those who turn their backs upon such a record, and demand that the whole system that has produced these results must be scrapped and overhauled!

Sure, much more remains to be done. The job never will be finished. But I for one believe that today's problems are not a reason for repudiating the splendid progress of the past. I believe rather that past progress should form the basis of our future efforts to manage wisely our natural resource heritage.

Today some preservationists are fond of quoting Darwin's phrase "adapt or die." But mankind has survived—and man is the only mammal that has survived from the Quaternary Age—because he has learned to adapt nature to himself, as well as vice versa.

A few years ago it became apparent that the Mississippi was about to choose a new course to the Gulf of Mexico—was in fact on the verge of taking over the valley of the Atchafalaya.

This change would have meant havoc to both valleys. It would have been catastrophic to New Orleans and the other communities of the present Mississippi Valley. It would have been equally catastrophic to the wilderness values of the Atchafalaya. So the Corps of Engineers recommended and built a project to stop this change-over of the valleys.

Was this preservation, or was it development? What's the difference? Perhaps we would be wise to use the word "adaptation" to environmental and developmental proposals alike, and thus avoid the derogatory connotations that are forming about both of these terms.

Today, on the basis of fears and alarms that seem to me grossly exaggerated, we are being asked to sacrifice many of the gains of modern civilization to achieve a "no growth" society. Such a policy in a society as dynamic as America appears to me as dangerous as it is unnecessary. It would mean deliberately inducing a permanent economic recession, with all its disruption—disruption as destructive of environmental values as of all others.

We would, in effect, be saying to the less privileged members of our society: "Since the economy will no longer grow, anything you gain from now on must be at the expense of somebody else."

I find it hard to believe that our economy can be converted to one based on cottage industries and parochial communities and markets except at grave and unpredictable risk.

So I must ask of those who advocate "no growth" on environmental grounds whether the harm done to the environment by our modern civilization really justifies such an upheaval.

Perhaps modern civilization has not been as considerate of environmental values as we can see by hindsight it should have been. We can do much better in the future. But I believe that today we are seeing in some quarters a potentially very dangerous over-reaction that conceivably could become a greater threat to all values, environmental values included, than past development.

I have been impressed by some thoughts that Charles L. Gould, the publisher of the *San Francisco Examiner,* has been expressing in speeches here and there. He reminds us, in effect, that no other people have ever accomplished so much and given so much and asked so little.

We have upheld freedom in all parts of the world without coveting a single acre of anyone else's territory. Instead, we have used our strength and our own wealth to aid the vanquished and the poor of more than a hundred nations, regardless of race or nationality, friend and foe alike.

We have struggled for progress and betterment at home. We have conquered many great plagues. We have built more schools and colleges and hospitals and libraries than any other generation in any other land. We have trained more scientists, doctors, lawyers, teachers, engineers and physicists than our forebears for thousands of years before.

We have raised our standards of living and lowered our hours of work. We have taxed ourselves unmercifully to bring hope and health to the sick, the poor, the young and the old. We have done more to bring dignity and equality and opportunity to minority groups than any other generation has ever done in any nation since the dawn of history.

Sure, there is still work to be done. There always will be. There are still challenges to be met, hopes to be realized, goals to be attained. There always will be. But they will *not* be attained by the teachers of fear or despair, by those who cop out, by "no growth." They *will* be attained by continuing on the course that has given us the magnificent gains already achieved—the course of courage and responsibility and enterprise. In other words, by the American way. The world has never seen a better way.

RDT&E, Materiel Procurement Contracts Total $482.9 Million

Army contracts for research, development, test, evaluation and procurement of materiel and services announced during June, each exceeding $1 million, totaled $482,930,623.

General Dynamics Corp. received the largest award of $47,732,761 for engineering development of the Stinger weapons system. The Atlas Corp. and H. D. Smith Construction Co. won a $28,491,992 contract for logistics support of Kwajalein Missile Range.

Diamond Reo Trucks will be paid $19,230,710 for M602 2½-ton trucks. LTV Aerospace Corp. gained a $18,452,219 contract for Lance missiles and ground support equipment. National Presto Industries, Inc., was awarded a $16,107,780 contract for 105mm HE, M1 projectile parts and Litton Systems, Inc., was issued a $13,536,250 contract for a segment of a tactical operations system.

Chrysler Corp. gained an $11,246,631 contract for tanks, chassis and trainers, Bendix Corp., $10,500,000 for classified electronic equipment, and Hughes Aircraft Co., $10,356,960 for TOW hardware for foreign military sales.

Contracts under $10 million. Martin Marietta Corp., $9,993,932 for industrial engineering services for the Pershing; Western Electric Co., $9,955,356 for installation, site support and testing for the Safeguard Ballistic Missile Defense System; Southern Airways of Texas, $9,933,769 for training of helicopter pilots, maintenance of aircraft repair parts and associated services; and

FMC Corp., $9,615,900 for M548 6-ton full-tracked cargo carriers; New Mexico State University, $7,181,850 for data reduction analysis and processing and computer operation support services; Control Data Corp., $7,128,820 for a 7600 computer system; Chrysler Corp., $7,000,000 for system engineering management of the M60 series vehicles; and

The Boeing Co., $6,816,351 for a radio frequency simulation system; Maremont Corp., $5,765,350 for M60 7.63mm machineguns with accessories; Marathon LeTourneau Inc., $5,733,000 for M117A3 bomb parts; Chrysler Outboard Corp., $5,612,100 of a third increment for military standard engines; GTE Sylvania, Inc., $5,319,200 for central office telephones; and

Raytheon Co., $4,919,400 for Hawk equipment and depot maintenance work; McDonnell Douglas Corp., $4,891,002 for R&D on the Spartan missile; Textron, Inc., $4,610,443 for UH-1H utility helicopters; RCA Corp., $4,362,400 for classified R&D; North American Rockwell, $4,305,093 for design of a special infrared sensor and rocket engines; and Western Electric Co., $4,199,475 for site activation, test materials, repair parts and support of the Safeguard ABM System; and

Dynalectron Corp., $4,182,880 for maintenance services in Vietnam; Etowan Mfg. Co., $4,158,250 for M557 fuze parts; Chrysler Corp., $4,136,000 for M60A1 tanks; AVCO Corp., $4,095,766 for generators; Institute for Defense Analyses, $4,080,000 for basic and applied research for the Director of Defense Research and Engineering and the Advanced Research Projects Agency; and

Hercules, Inc., $4,075,000 for Sprint missile production motor loading and igniter manufacture; Electromagnetic Systems Laboratory, $4,000,000 for R&D on electronics equipment; Hughes Aircraft Co., $3,932,159 for TOW industrial engineering services; Federal Electric Corp., $3,849,400 for operation and maintenance of the Integrated Communications System and the Dial Telephone Exchange; and

Western Electric Co., $3,358,500 for Safeguard ABM training; Hughes Aircraft Co., $3,356,575 for AN/VVG-1 laser rangefinders; Sierra Research Corp., $3,230,000 for switch modification kits for the Nike Hercules mis-

(Continued on page 44)

TACOM Seeks New Reconnaissance Vehicle With 2 Contracts Totaling $26 Million

Prototypes of two proposed concepts of an Armored Reconnaissance Scout Vehicle will be produced under contracts awarded by the U.S. Army Tank-Automotive Command (TACOM), Warren, Mich.

The contracts, totaling about $26 million, mark the beginning of the prototype validation phase of a program for development and eventual production of a new vehicle to replace the M114 series Command and Reconnaissance Vehicle. Competitors are the FMC Corp. and the Lockheed Missiles and Space Co.

The Scout will be lightly armored, highly mobile, and capable of swimming or being carried by helicopter or transport aircraft. It will be small enough to be easily concealed and, because of its reconnaissance mission, will be required to accelerate rapidly and travel at a relatively high rate of speed on hard surface.

During the initial concept formulation phase of the program, industry had a wide latitude in submitting proposals, because both wheeled and tracked concepts are being evaluated.

The FMC proposal is a tracked vehicle concept that will feature four road wheels and a flat aluminum track with steel guides. Weighing about 18,000 pounds, it will have a 2-man weapon station armed with a 20mm M139 gun.

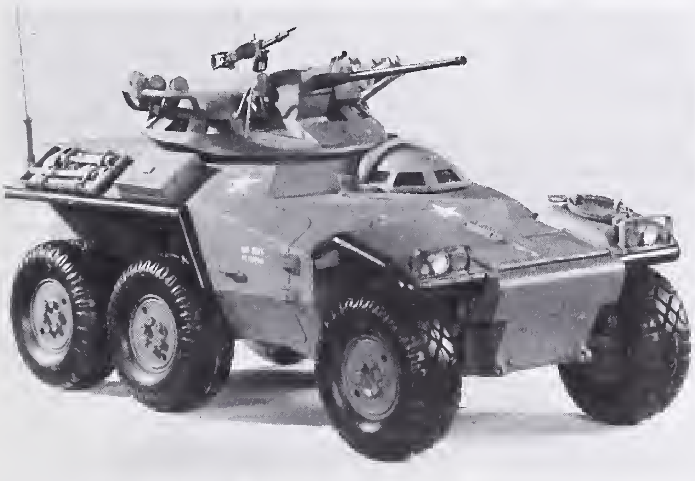
The Lockheed version is a 6-wheeled articulated vehicle. Unlike other articulated vehicles designed to permit independent roll, pitch and yaw of the front and rear bodies, the Lockheed vehicle will feature only roll articulation.

Contracts call for each producer to build four vehicle prototypes and deliver three of them to the Army within 18 months for testing. The remaining two vehicles will be retained by their respective contractors for use as test-bed vehicles.

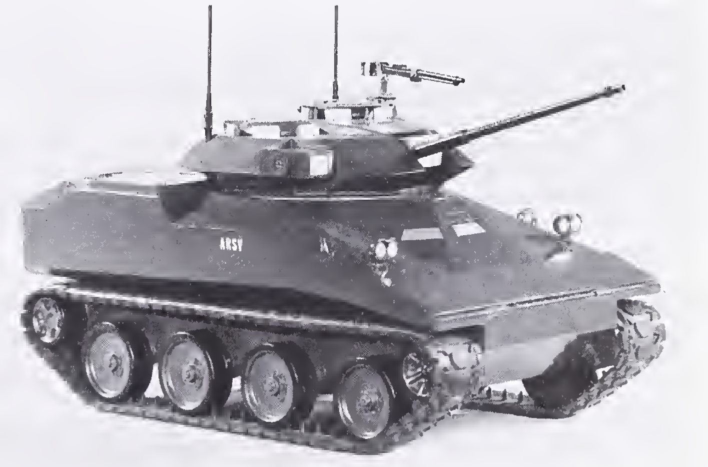
When they are delivered, the vehicles will undergo extensive durability and mobility tests for six months at Aberdeen Proving Ground, Md., and Fort Knox, Ky. Four months after the delivery of the vehicles, both contractors will submit proposals for the follow-on program, which consists of advanced production engineering and limited production.

After a careful review of the submitted proposals and a thorough analysis of the field test results, a final decision will be made whether to adopt the tracked or wheeled vehicle concept. A follow-on program contract will then be awarded to either FMC or Lockheed.

The FMC and Lockheed vehicle proposals are among six that were submitted after TACOM released solicitations to industry in October 1971.



Lockheed Missiles & Space Co. wheeled concept of ARSV.



Food Machinery Corp. tracked concept of ARSV.

Memorandum Delineates:

'Basic Policies for Systems Acquisition by Department of the Army'

Secretary of the Army Robert F. Froehlke and retired Army Chief of Staff General William C. Westmoreland signed a recently issued memorandum prescribing materiel acquisition guidelines. Addressed to major Army commanders and heads of Army staff agencies, it states in part:

"To assure that the Army maintains its combat superiority over any potential opposing force, it is essential that we continually equip our forces with sufficient numbers of technically superior weapon/materiel systems, which have been developed, acquired and fielded at the lowest possible cost. Our systems acquisition process is the key to maintaining this superiority."

Instructions implementing what is being termed an "R&D Manifesto" are detailed in a newly published regulation (AR 1001-1), "Basic Policies for Systems Acquisition by the Department of the Army."

The AR states that "there is no simple, single formula which will apply to the acquisition of all systems" but describes two general approaches—one applying to larger, more expensive or more important systems and another for all other acquisitions.

Six basic policies, together with certain related procedural steps, are termed "the framework of a realistic acquisition program for the Department of the Army."

The TAG Letter continues as follows:

1. *Shortened Requirements Generation Time.* The requirements generation process must be shortened, the amount of detail and output reduced, and the quality of the product improved. The first step in the development of a system must be the establishment of a Required Operational Capability (ROC). A ROC may originate anywhere in the Army—at one of the schools or centers, in one of the operational commands, in the Army Materiel Command (AMC), Combat Developments Command (CDC), Army Staff, Secretariat, or the idea might originate with industry.

Generally speaking, a ROC will be produced when a technological opportunity appears, when potential enemies are developing equipment superior to ours, or when there is a general consensus that equipment in the hands of troops will soon be obsolescent.

This paper concentrates primarily on the acquisition process for major systems. However, at the outset it is important to describe the process as it relates to any system. The steps in the development and approval of a ROC are as follows:

a. The originator of a ROC will submit it to the Assistant Chief of Staff for Force Development (ACSFOR).

b. The originator will provide rationale and data to the extent it is available to him in the following categories: (1) Statement of need; (2) Time frame; (3) Threat/operational deficiency; (4) Operational/organizational concept; (5) Essential characteristics; (6) Technical assessment (broad); (7) Cost assessment (broad).

c. It is desirable that the size of the ROC be minimized. Four pages seem to be a reasonable goal for most systems.

d. The ACSFOR will determine whether the ROC as submitted is adequate and, if it is not, will call for added definition by the originator or by the most appropriate Army agency. For example, ACSFOR could direct preparation of the required added definition by the Strategic Communications Command, the Army Air Defense Command, AMC, CDC, or others.

e. ACSFOR, in coordination with Chief of Research and Development (CRD), will approve the ROC for other than major systems, and will designate the using command or agency with which the developers are to coordinate. The CRD will be directly responsible for the General Staff management of the development of other than major systems. Prior to authorizing the development of the system by the developer, the CRD may require the development for his review of a concept formulation package and development plan. Thereafter, he may establish such reviews and controls as he deems necessary.

f. ACSFOR, in coordination with CRD, will determine which systems are to be considered major. They would include those which qualify for a Defense Systems Acquisition Review Council (DSARC) and any others which are critically important to the Army, complicated, expensive, controversial, or for other reasons should involve the top management of the Army. ACSFOR will be responsible in these cases for processing the ROC for approval. At this time ACSFOR should indicate in general terms how the new system would be integrated into the Army's force and resource program. ACSFOR will also be responsible for setting in motion the special management policies and procedures outlined hereafter in this document.

g. After the approval of a major system ROC by the Department of the Army, a special Task Force will be assembled to prepare the Concept Formulation Package (CFP), the development plans and associated analysis, including a draft Development Concept Paper (DCP), for consideration by the Army Systems Acquisition Review Council (ASARC) (described later).

Members of the Task Force will be drawn from the user (the appropriate command), the developer (AMC), the architect (CDC, schools and centers), and the buyer (DA Staff) communities. The Task Force leader should be the best man in the Army for the job and the prospective project manager should be on the Task Force.

The Task Force's job is to conduct the necessary alternative system design investigations which, through an iterative process considering technical, schedule, and cost constraints, arrives at a recommended approach to fulfill the system need. This output will provide the necessary data to support a decision at the Department of Army and OSD level to initiate development.

Specifically, the Task Force will produce a draft DCP and the CFP. In cases where the Task Force recommends proceeding into advanced development, the report of the task force will include: (1) Systems summary; (2) systems requirement and analysis; (3) discussion of alternatives considered and relationships to other systems; (4) plan for system development; (5) technical portion of the RFP; (6) financial and procurement plan; (7) plan for test and evaluation.

In cases where the Task Force recommends proceeding into engineering development, development plans will also address personnel

Chief of R&D Comments on Materiel Acquisition

Army Chief of Research and Development LTG William C. Gribble Jr. issued the following statement regarding changes in the materiel acquisition process:

Secretary of the Army Froehlke and former Chief of Staff General Westmoreland released, on June 22, the text of their memorandum to major Army commanders and staff agency heads providing new policy guidance on the Army's materiel acquisition process.

The policy memorandum is a logical Army extension and expansion of Department of Defense Directive 5000.1 of July 1971. The Army memorandum translates the philosophy of the 5000.1 directive into definitive Army-oriented instructions and adds additional policy guidance to reflect Army implementation.

Policy changes occur in six specific areas: Shortened requirements time, high-level decision-making, shortened development time, funding priorities, cost versus quantity, and program cost control. A detailed letter of instructions amplifying the policy is now being prepared. This letter will provide additional guidance and authority until such time as the appropriate Army regulations can be revised.

Because of the significant changes in the interface areas of Army R&D and its industrial partners, I believe it beneficial to all concerned that they have early access to the full content of this policy.

and training requirements and logistical support planning.

h. Goals for life cycle costs will be included in development plans, which will also include major performance characteristics expressed in terms of allowable bands. Performance characteristics rather than design specifications will be stated. It is intended that the project manager keep performance within the bands specified while remaining within the goals and thresholds established for life cycle cost, development cost, and schedule.

Secondary characteristics describing desirable but not necessarily essential features of a system will undoubtedly be generated in the course of the concept formulation process. Generally, trade-offs with respect to the manner of meeting these secondary characteristics will be left to the project manager as the program proceeds, provided such trade-offs do not cause established thresholds to be violated.

i. The analysis of the impact of a new system on force design and other related systems, as well as the program impact, will be provided by the active participation of OACSFOR on behalf of the Army Staff to assure that the draft DCP, including system costs, quantities and schedules, is fully compatible with the resources available to the Department of the Army.

j. All agencies and commands will support the Task Force, and much of the work will be done by other commands and organizations under the supervision of the Task Force. For example, the plan for system development, and the RFP, would undoubtedly be prepared by AMC for the Task Force.

k. Normally, a Task Force will be dissolved not later than completion of DSARC I, at which time the Project Manager will assume management responsibility for the system.

2. *High-Level Decision-making.* The top managers of the Army will participate personally in face-to-face decision-making on major weapon systems development. The Army Systems Acquisition Review Council (ASARC), dicussed below, will be the vehicle for such decisions. To save time and yet not sacrifice thoroughness of review, agencies represented on the ASARC will have access to analyses through parallel distribution of reports at least two weeks in advance of the ASARC meeting.

a. An Army Systems Acquisition Review Council (ASARC) system paralleling the DSARC system will be responsible for ASARC/DSARC preparation.

AGENCY	*MILESTONE*	*REVIEW*
ACSFOR	Enter Validation	ASARC I/DSARC I
CRD	Enter Full-Scale Engineering Development	ASARC II/DSARC II
ACSFOR	Low-Rate Initial Production	ASARC IIa/DSARCIIa
DSCLOG	Full-Scale Production	ASARC III/DSARC III

The following principals are members of ASARC:

Vice Chief of Staff (Chairs)
Assistant Secretary of Army (FB)
Assistant Secretary of Army (R&D)
Assistant Secretary of Army
Deputy Under Secretary of Army (OR)
Assistant Chief of Staff for
Force Development
Comptroller of Army
Chief of Research and Development
Deputy Chief of Staff for Logistics

b. Headquarters, Department of the Army will make the major decisions, delegating derived or subordinate decisions to the maximum extent possible. Major decisions will be an outgrowth of ASARC deliberations.

c. After ASARC I, the Army will make a maximum effort to assure the acquisition of the system within the shortest reasonable time. Between scheduled ASARCs, a challenge to the system under development will be considered only if it is supported by solid evidence of a problem, the solution to which cannot be postponed until the next ASARC.

A major change in enemy threat and/or cost, schedule, or performance of a system reported in a Selected Acquisition Report (SAR) should result in the convening of a special ASARC. Initial Operational Capability (IOC) will not necessarily be a fixed factor in system acquisition; rather, it may be a trade-off to be considered among other factors.

3. *Shortened Development Time.* Actual developmental time should be shortened to approximately six years from ASARC I to IOC when this can be done without inordinate risks. This will require, in most cases, the availability of developed components to support the ASARC I decision to enter validation, and, secondly, a willingness to initiate producibility engineering and planning (PEP) no later than the beginning of engineering and service tests.

a. The time to accomplish procurement actions must be reduced so that contractor response, evaluation, selection, approval, and contract award can be accomplished in less than six months after release of the program to the developer following an ASARC I. This validation phase may include competitive fabrication of end item prototypes for evaluation by the Army.

At the conclusion of the validation phase, the desirability of entering into full-scale engineering development will be determined by a high-level review (ASARC II). Such approval will normally result in the award of a contract to a single contractor, determined to be the most capable to complete development and first production, particularly if competitive advance development prototypes have been tested.

b. All testing will be divided into two broad categories: development testing (DT) and operational testing (OT). Development testing will be conducted by AMC and will include engineering testing and that part of service testing which assesses operability and maintainability of the system by the prospective user. Initial production testing will be considered as the final phase of development testing.

Operational testing will be conducted beginning with early prototypes prior to the initiation of low-rate production and continuing through production models. Operational testing will be conducted by user troops or individuals, preferably in units, to determine if the system is operationally suitable from a doctrinal, organizational, and tactical point of view and to collect performance and reliability, availability, and maintainability (RAM) data for the equipment when in the hands of troops..

c. The development testing/operational testing preceding DSARC IIa should be planned and conducted so that important characteristics have been subjected to test within the first six months. The major output of DT/OT at this time should answer the question: "Is the system basically OK, can any identified deficiencies be corrected, and if corrected, do we want the system considering what we already have?"

If, on the basis of this output, the decision is made to proceed, a final check on these corrections will be obtained in subsequent DT/OT testing. Agencies represented on the ASARC must have advanced access to test results through parallel distribution of test reports and briefings so that review time can be minimized. The resulting decision briefing for the ASARC should be presented by approximately the six-month point. Unless a DSARC IIa has been requested and scheduled, an ASARC IIa decision to proceed at this point will authorize low-rate initial production.

d. A Producibility Engineering and Planning (PEP) phase (RDTE funded) will be conducted, and should begin no later than the beginning of ET/ST, but must be timed so that it will be possible to insert test results in the PEP process. It is recognized that PEP expenditures during this time are at risk and may be lost if the decision is not to proceed with production.

e. Subsequent to ASARC/DSARC IIa, final production engineering, the procurement of long-lead-time items, and hard tooling will be initiated with PEMA funding. Production will be initiated at a low rate on tooling/processes which can support full-scale production, either directly or by duplication.

f. It should be a goal to accomplish final DT/OT, using the low-rate initial production units, in a maximum of six months. The main goals of DT at this time are to show that the production units have the capabilities demonstrated by the prototypes, including required fixes, and to show that the transition to production has been made successfully.

Operational Testing (OT) of low-rate initial production units is intended to determine: (1) The over-all system's field effectiveness in the hands of troops (benefits vs burdens) to include performance against expected countermeasures; (2) the system's maintainability and reliability within the limits of the test period; (3) the readiness of the system for deployment in terms of basis of issue, organization tactics, and the training package.

g. After satisfactory final DT/OT, full-scale production will be authorized by ASARC/DSARC III.

h. The Army must complete production contracts as early as possible for the sake of economy. Generally, complex or urgently

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Army Science Conference . . .

Highlights include Froehlke, Gribble addresses; presentations on R&D by speakers of 5 foreign nations; panel discussion; 19 award papers

Secretary of the Army Robert F. Froehlke's address, speeches on R&D trends by five foreign nations defense officials, and award of Dr. Paul A. Siple Memorial Medallions with a $1,000 honorarium to a 7-man Edgewood (Md.) Arsenal research team featured the 1972 U.S. Army Science Conference.

In a large measure, however, the conference at the United States Military Academy, West Point, N.Y., was a poignant tribute to the man who originated the ASC in 1957 and served continuously as its general chairman.

Unforgettable to all banquet attendees was Secretary Froehlke's call upon Army Research Deputy and Scientific Director Dr. Richard A. Weiss to read, with his arm around the honoree's shoulder, a Letter of Appreciation for 15 years of exceptionally outstanding service in advancing the ASC to international significance. Dr. Weiss retired June 30, ending more than 31 years in government service.

Contributing to the consensus of more than 400 participants that the conference was an impressive success were a keynote address by Army Chief of Research and Development LTG William C. Gribble Jr.; a high-level panel discussion on "Realiability, Availability and Maintainability" as applied to military materiel; and the high quality of 100 technical presentations.

When Assistant Secretary of the Army (R&D) Robert L. Johnson was unable to keep a commitment to present the awards to authors of the best technical papers, it was decided that the honor logically should be delegated to Dr. Weiss—in recognition of his long and distinguished service in stimulating the pursuit of excellence in research within Army in-house laboratories.

Through the U.S. Army Incentive Awards Program, a total of $3,700 in cash honorariums and Certificates of Commendation were awarded to authors and coauthors of nine papers. Ten additional papers were adjudged as outstandingly meritorious.

Selected for the most prestigious ASC award—the Dr. Paul A. Siple Memorial Medallion honoring the internationally renowned U.S. Army cold regions explorer and scientific adviser who died in November 1968—was a paper titled "A Vaccine Against Organophosphorus Poisoning."

This is a report on research at Edgewood Arsenal that has demonstrated the feasibility of immunization for temporarily disabling nerve gases that might be used to incapacitate the populace against an enemy attack. Further research is needed, it was stressed, to validate the findings to date, representing over 10 years of investigative effort.

Members of the research team are Dr. Ludwig A. Sternberger, Dr. Van M. Sim, CPT William G. Kavanagh, John J. Cuculis, Howard G. Meyer, Dr. David E. Lenz and Dr. Dennis M. Hinton. All are employed in the Biomedical Laboratory.

Secretary of the Army Robert F. Froehlke and Dr. Richard A. Weiss

Second-place awards of $500 each and bronze medallions were shared by two 2-member teams. Dr. Fred E. Hahn and Miss Jennie Ciak, Walter Reed Army Institute of Research, Washington, D.C., coauthored "Restoration of Drug-Resistant Bacteria to Sensitivity to Chemotherapeutic Drugs."

This research report is considered important in relation to the problems of malaria control that have been experienced by U.S. Armed Forces during combat in Southeast Asia, where malaria germs have developed immunity to certain control drugs.

Bronze medallions—a 1970 innovation at the Bronze medallions—an innovation at the conference to complement the 3-inch silver Siple Memorial Medallions—and $500 were presented also to Dr. Robert E. Ormiston and William G. Bousman, Army Air Mobility Research and Development Laboratory, Ames Research Center, Moffet Field, Calif. They coauthored "A Theoretical and Experimental Investigation of Flap-Lag Stability of Hingeless Helicopter Rotor Blades."

Two papers won identical awards of $350 and bronze medallions. "Stability of Ammonium Nitrate as Inferred from Structural and Lattice Dynamical Studies" was coauthored by Chang S. Choi, Zafar Iqbal, Henry J. Prask and Samuel F. Trevino. All are employed in the Explosives Division, Feltman Research Laboratory, Picatinny Arsenal, Dover, N.J.

Coauthors of the second $350 paper are Robert L. Wintermyer, Mrs. Linda Szafraniec, Harvey R. Bradford and Harold Klapper, all with the Chemical Laboratory at Edgewood Arsenal. They collaborated on "The Kinetics and Mechanism of the Binary GB Reaction as Determined by NMR Spectroscopy."

Four papers won identical awards of $250 each and bronze medallions. BG Surindar N. Bhaskar, director of the U.S. Army Institute of Dental Research, presented "Role of Water Jet Devices in Combat Surgery." This is a report on a dramatic new technique that has produced amazing results when applied to badly lacerated patients. His associates in this research are COL Duane E. Cutright and LTC Arthur Gross. (See feature article on page 14.)

Another of the $250 papers is titled "The Ring Airfoil Grenade," a dynamically different type of ammunition, shaped much like a doughnut, that has demonstrated superior range due to its "flying capability." The paper was authored and presented by Abraham Flatau, Chemical Laboratory, Edgewood.

The third $250 paper, "Shaped Charge Liner Collapse and Jet Formation—Analytical and Experimental Investigations," was coauthored by Glenn Randers-Pehrson and Bruce G. Knutelsky, Feltman Research Laboratory. The fourth winner was "A Novel Synthesis of HMX," a report on research for high-powered ammunitions, coauthored by Victor I. Siele, Maurice Warman, John Leccacorvi and Everett E. Gilbert, all employed in the Explosives Division of the FRL.

Certificates of Achievement signed by Assistant Secretary of the Army (R&D) Robert L. Johnson and Chief of R&D LTG William C. Gribble Jr. were presented to authors and coauthors of 10 meritorious papers, as follows:

- "The Automated Dithionite Test for the Detection of Hemoglobin S. in Military Personnel. A Technic Evolved from Molecular Concepts," LTC Frank R. Camp, COL Nicholas F. Conte and Dr. Robert M. Nalbandian, U.S. Army Medical Research Laboratory, Fort Knox, Ky.
- "The Effect of Folate on Abnormal Carbohydrate Metabolism," MAJ Harry L. Greene, COL Robert H. Herman, Dr. Fred B. Stifel, Mrs. Yaye F. Herman and LTC Edward G. Lufkin, U.S. Army Medical Research and Nutrition Laboratory, Fitzsimons Army Hospital, Denver, Colo.
- "Human Engineering Laboratory Battalion Artillery Tests (HELBAT)," Gary L. Horley, Human Engineering Laboratory, Aberdeen (Md.) Proving Ground.
- "Anistropic Dose and Its Applications in Directional Radiation Sensing," Dr. Stanley Kronenberg, Dr. Robert A. Lux, Dr. Wolfgang J. Ramm, Kristian L. Nilson, Robert L. Pfeffer and Harry L. Berkowitz, U.S. Army Electronics Technology and Devices Laboratory, Electronics Command, Fort Monmouth, N.J.
- "The Effects of Vibration on Vision as Applied to Military Vehicles," Richard A. Lee, U.S. Army Tank-Automotive Command, Warren, Mich.
- "Stress Singularities Associated with a Crack Inclined to a Bimaterial Interface," San L. Pu, Raymond D. Scanlon and Dr. Moayyed A. Hussain, Benet Weapons Laboratory, Watervliet Arsenal, N.Y.
- "Electronic Processes in Explosives Initiation," Dr. Harry D. Fair, David S. Downs, Arthur C. Forsyth, Marcel Blais and Thaddeus F. Gora Jr., Solid State Branch, Explosives Division, FRL, Picatinny Arsenal.

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Scenes at 1972 Army Science Conference

(1) TOASTMASTER Dr. Ralph G. H. Siu, who has filled that role for six of the eight U.S. Army science Conferences, in addition to presenting the keynote address in 1970, was caught up by the cameraman at the banquet table in an uncharacteristic mood—perhaps thinking about the farewell appearance of his close friend for more than two decades, Dr. Richard A. Weiss. Dr. Siu is usually the rollicking humorist who adds the joy of living to any social gathering, and his 1972 performance as toastmaster was true to reputation.

INFORMAL DISCUSSIONS, typical at Army Science Conferences, involve (2) D. R. Squire, ARO-D; D. B. Rosenblatt, Frankford (Pa.) Arsenal; Dr. R. Lux, ECOM; Dr. Stanley Kronenberg, ECOM; Dr. J. J. Antal, AMMRC; Dr. F. D. Verderame, Frankford Arsenal. (3) MAJ Christian Marchand, French Embassy; COL M. A. Cauchie, French Ministry of Defense; Dr. R. A. Weiss, OCRD; Dr. G. D. Dorough, ODDR&E; M. L. Martin, OCE. (4) Dr. W. Webb, WSMR; Dr. Mary Mandels, NLABS; Dr. Janet Perkins, AMMRC; Dr. R. H. Duncan, WSMR. (5) Dr. William Carter, HDL; Dr. B. L. Harris, Edgewood Arsenal; Dr. I. R. Hershner, OCRD; Dr. R. L. Haley, OCRD; P. F. Carlton, OCE. (6) Dr. R. B. Dillaway, AMC; BG J. R. Jannerone, USMA; E. D. Treharne, Australian Embassy; Dr. R. L. Heley, OCRD; Dr. Heinz Damm, Federal Republic of Germany. (7) CRD LTG William C. Gribble Jr.; Secretary of the Army Froehlke; LTG W. W. Vaughan, AMC.

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Army Science Conference . . .

Highlights include Froehlke, Gribble addresses; presentations on R&D

(Continued from page 24)

- "Studies in Personnel Detection Radar," Dr. Carol A. Roberts, Richard T. Antony and Salvador J. Peperone, Harry Diamond Laboratories, Washington, D.C.
- "Growth of Large Single Crystals of Al_2O_3 by the Gradient Furnace Technique for Transparent Armor Applications," Dr. Dennis J. Viechnicki and Frederick Schmid, Army Materials and Mechanics Research Center, Watertown, Mass.
- "A Ballistic Research Laboratories Lightweight Armor Concept," Alfred B. Merendino and Joseph M. Regan, Ballistic Research Laboratories, USAARDC, Aberdeen (Md.) Proving Ground.

The panel of judges that selected award-winning papers included Dr. Robert A. Beaudet, Department of Chemistry, University of Southern California, Berkeley; Dr. Anthony R. Curreri, director, Division of Clinical Onocology and professor of surgery, University of Wisconsin Hospitals; Prof. Enoch J. Durbin, Department of Aerospace and Mechanical Sciences, Princeton University; Donald G. Fink, general manager, Institute of Electrical and Electronic Engineers, Inc., and Dr. David L. Fried, Optics Science Consultants.

Army Chief Scientist Dr. Marvin E. Lasser, presiding chairman of the conference, also chaired the panel of judges.

BANQUET ADDRESS. Secretary of the Army Froehlke's address to about 450 banquet attendees was a prideful, offer-no-apologies endorsement of the U.S. Army record in Southeast Asia—topped off by confidence that the future Army will attain the goal of a truly professional all-volunteer force. (For the text of his address, see page 37.)

Toastmaster Dr. Ralph G. H. Siu introduced Secretary Froehlke as "a man who has demonstrated a genuine appreciation for people as individual human beings. He doesn't just say that he appreciates the advice and opinions of his associates and subordinates. He eagerly solicits and listens to them.

"He doesn't just say that he appreciates the scientists and engineers in the Army. He comes up to where they are. He visits with them. He talks to them. It is my great privilege to introduce the first Secretary of the Army ever to address an Army Science Conference."

Apparently as a complete surprise, since he had to repeat the invitation to come forward to the podium, Secretary Froehlke opened his address by calling upon Deputy and Scientific Director of Army Research Dr. Richard A. Weiss. Then, with his arm around Dr. Weiss' shoulder, he read a letter "written that morning" for personal delivery at the banquet. The letter follows:

"On the occasion of the Eighth Army Science Conference, it is appropriate to recognize the contributions that you have made to ensure the success of these events. In 1956, as the Scientific Adviser to both the Chief of Research and Development and the Director of Army Research, you conceived and proposed the first Army Science Conference.

"Then, as now, you served as general chairman, responsible for the planning and organization of the conference. That first conference, held in 1957, brought together 300 of the Army's best scientists and engineers. It marked the first in this series of conferences which tie together the diverse scientific interests of the Army; demonstrate the scope and depth of the Army's scientific and technical missions; and provide a means of bringing such achievements to the attention of the Department of Defense, other federal agencies, and our allies.

"As you prepare for retirement later this month, after 31 years of service with the Army, I am delighted to commend you for your devoted service as founder and general chairman of the Army Science Conference. Warmest regards. Sincerely, Bob Froehlke."

Dr. Weiss responded with an equally warm tribute to the military project officers at the Army Research Office and the U.S. Military Academy for their contributions to the continuing success of the conference:

"I want to say that Bill (LTC) King and his counterpart from the Academy (MAJ William Sexton) are responsible for the success of this conference, and his predecessors in the past have been, too. We have just been the actors carrying out the things that they have planned."

In a brief review of some of his observations during previous Army Science Conferences, and factors responsible for their continuing success, Dr. Weiss cited the sustained high-level support.

Special acknowledgement was given to Army Chief Scientist Dr. Marvin E. Lasser for "tremendous knowledge and vitality," to the U.S. Military Academy staff as hosts, and to the panels of judges for the consistently high quality of the technical paper presentations.

FOREIGN GUEST SPEAKERS. One of the 1972 ASC innovations was the presentation, by representatives of the five foreign nations, of technical papers reporting on research and development trends in their countries. Three of the five papers were classified, making it necessary to limit these reports to publication in restricted conference proceedings.

BG Hans Ludwig Eberhard, head of the Army Technology Division, Ministry of Defense, Federal Republic of Germany, and Dr. Heinz Damm, Defense Research attache, German Embassy, Washington, D.C., collaborated on one presentation. They described development of German weapon systems, reconnaissance and detection devices, mobility vehicles and other equipment.

French research and development activities were reported by Marc A. Cauchie, chief engineer and deputy director for International Cooperation, Ministry of Defense. He was supported by MAJ Christian Marchand, assistant military attache, French Embassy. The report covered surveillance devices, missiles and conventional weapon systems, new power sources, and mobility.

The United Kingdom presentation was given by David Cardwell, director of the Military Vehicles and Engineering Establishment, supported by Brigadier Frederick Ward, assistant defense attache and director, Munitions Group, British Embassy. Much of this report was a discussion of changes in the organizational structure for R&D and procedures, as well as an explanation of materiel trends.

Defense Science Attache Elgar Treharne, Australian Embassy, reported on R&D trends in his country and on some of the collaborative R&D efforts with the United States. Canadian Defence Research Board R&D activities were reported by Dr. Norman J. B. Wiggin, deputy chairman of the board, backed up by Benjamin O. Baker, counsellor for defense research, Canadian Embassy.

PANEL DISCUSSION. Jack I. Hope, Office of Science and Technology, Executive office of the President, presided as chairman of a 6-member panel discussion on "Reliability, Availability and Maintainability" (RAM), as related to designing, engineering and developing military materiel to meet these objectives.

Industrial presentations on RAM were made by Thomas E. Battle, chief engineer for engines, Truck Division of International Harvester Co., representing the automotive industry; Stuart Miller, manager of Reliability and Quality Assurance, Aerospace Electronic Systems Department, General Electric Co., representing the electrical and electronic industry; and Howard Stuverude, vice president and general manager, Boeing Vertol Division, representing the aerospace industry.

Academic representation on the panel was provided by Martin L. Shooman, Polytechnic Institute of Brooklyn, N.Y., whose highly technical contribution was based on the best paper presented at the 1972 annual Institute of Electrical and Electronic Engineers Symposium on Reliability. It was titled "Techniques of System Reliability Prediction."

Military viewpoints were presented by LTG W. W. Vaughan, deputy CG of the Army Materiel Command, and MG Curtis Chapman, deputy CG of the Combat Developments Command, who was unable to attend. His paper was read by Mr. Hope.

Immensity of the problem of developing effective methodology to attain Army goals for RAM was statistically stated by LTG Vaughan when he started his presentation by pointing out that the Department of Defense currently is spending about $20 billion a year to maintain $104 billion worth of weapon systems and equipment.

This vast expenditure, he explained, includes the cost of 1.5 million man-years of maintenance, both in-house and performed under contract, and operating 20,000 shop facilities at 2,000 locations, plus 94 major depot maintenance facilities. His key questions: "How much of this cost is caused by excessive, unrealistic maintenance requirements? How much could have been precluded by built-in utility at the design stage?"

Narrowing the over-all problem to the Army Vehicle Program, both tactical and combat vehicles, he said: "Conservatively, we spend about $573 million annually for worldwide field and depot maintenance for tactical vehicles, using 52 million man-hours to do the work. For combat vehicles, this annual cost is $310 million with just over 8 million manhours expended."

Just by reducing the maintenance effort per vehicle by 5 percent, LTG Vaughan stated, an annual saving of $29 million of tactical and $16 million on combat vehicles could be effected.

The Army Materiel Command RAM Program objectives were listed as:

- Achievement of reliability for future systems.
- Improving the reliability of fielded systems.
- Building reliability through intensive R&D of components.
- Assuring reliability achievement in the transition from development to production of materiel.

For future systems, LTG Vaughan said the basic AMC approach will be to state clearly quantitative reliability requirements in materiel need statements; to apply vigorously reliability methodology during design; to demonstrate reliability achievement through soundly designed tests; and to pursue aggressive failure analysis and corrective action programs designed to foster reliability growth.

Through initiation of the RISE (Reliability Improvement of Selected Equipment) Program, the general said "some real pay-offs" were achieved. He cited, as an example, that by replacing the bearings for feathering and flapping controls on the Cobra attack helicopter, using new elastomeric bearings, an increase of service life from 300 to 2,500 hours is anticipated.

LTG Vaughan said one of the "enormous" problem areas in the RAM program is the transition from development to production. "We build a good R&D model, it tests well, but we have trouble when it is put into volume production—even when the R&D contractor is the producer. The AMC is now instituting more rigorous first-article qualification requirements, and demanding that prime contractors exercise more stringent control of vendors and processes.

"With the rapid race of technology," he said, "new developments find production applications with amazing rapidity. The developer can no longer remain in his scientific cubbeyhole, thinking only about tomorrow. . . ."

Scientists and engineers must become applicators as well as innovators, he said, explaining that this type of involvement will "help to solve our development to production problems."

In closing, LTG Vaughan said: "I suppose I might say that our job in reliability is to overcome Murphy's Law—'If something can go wrong it will'—and then O'Tool's precept: 'Murphy's Law is conservative.' "

MG Chapman's paper was titled "The Importance of RAM to the User of Army Materiel—the Soldier." Reliability to the combat soldier, it stated, is often the critical factor in determining success or failure. Simplicity of design to serve the goal of maintainability is similarly important to achieve availability—in that "the road to availability passes over the bridge of reliability and maintainability."

In reporting on Combat Developments Command RAM program activities, MG Chapman's paper explained that requirements for materiel are constantly being refined—characteristics are now jointly determined through face-to-face meetings among all interested Army commands and agencies. The emphasis is on a clearly stated specification of desired reliability characteristics.

The closing statement follows:

"I feel that the Army has come a long way in the past few years toward improving our RAM methodology. However, we cannot stop to reflect on our accomplishments. We must constantly improve this methodology if we are to challenge you to keep pace with the needs of the Soldier.

"While we don't feel that RAM is in its infancy, we do sense the shortcomings brought on by a population largely uneducated in its principles. It is apparent that we must also challenge our colleges and universities to furnish us engineers with new ideas and the patience and fortitude to stay with them. We also need to send our older engineers back to school so that they can keep abreast with new methodology.

"Gentlemen, you must reduce the burden on the Soldier. That's quite a challenge. The leadership for improving RAM for Army materiel must come from you. Industry and Government must work together to accomplish this goal."

Stuart Miller commented, at the outset of his presentation, on the parallel growth of reliability requirements and product complexity demands over the past 20 years. Then he stated:

". . . It is clear that a change in the practices of Reliability Planning and Management is mandatory. To meet this need, a methodology is required which has the credibility of an exacting science, incorporates the flexibility for alternative program planning, and contains standardization factors to facilitate a uniform evaluation structure suitable for application by both contractor and buyer."

In discussing aviation radar reliability and life cycle cost, he presented results of studies showing that for a 15 percent increase in development program cost, a 120-hour within-the-state-of-the-art radar could have been fielded in contrast to the 14-hour system deployed.

Amplifying on this theme, with respect to a study of utilization of 640 aircraft over a 10-year period, he said it showed "the maintenance cost alone will exceed 1.5 times the total acquisition cost, where if only $1 had been expended in reliability development proofing, it would have been worth approximately $100 in field maintenance savings alone."

Similar studies of weapon system avionics produced results similar to those of the radar example, he said, adding: "Each equipment required extensive test evaluation and improvement prior to achieving compliance, to correct design, workmanship, and materials deficiencies in approximately equal severity.

"The lack of initial compliance was equally applicable to a cross section of contractors and product types with complexity variation of 17:1. These initial results are typical of weapon systems designed with the modern technology, methods and automation of the 1960s."

Concluding his presentation with a statement of the experience of the electronics industry in considering factors from 10 diverse sources, Miller summarized Reliability Technology Status—known, available, understood and ready for uniform application. He said that:

- Credible reliability predictions are achievable in performance.
- New products initially perform at 10 percent of prediction.
- Reliability growth is projectable.
- Reliability development can be dimensioned, disciplined and managed.
- Fielded systems reliability does not grow.
- One dollar in R&D equals $100 in life cycle operation and maintenance.

Howard Stuverude discussed reliability studies of air vehicles, elaborating on the CH-47A and the fleet modernization program. Using the new composite materials which are rugged and durable, he said it is relatively simple to "substantially reduce the failure rate of such components and to reduce the corrective maintenance time.

"By starting from a sound data base, using actual down-time characteristics, one can assign maintenance down-time budgets to each subsystem and undertake the design test, fix, test, re-fix iterative process necessary to insure that the malfunctions per flight hour are reduced to an adequately low level, and that total maintenance corrective time is within reasonable budgets."

The factors involved, he said, are based on experience and studies of "millions of hours of flight time." He added that "Achieving such a level of reliability of the major dynamic components can cut the direct operating cost in half. . . ." Maintainability, that is the corrective maintenance per malfunction, was termed "a key factor affecting utilization."

Thomas Battle opened his automotive industry presentation by saying "the better the customer's specifications match the conditions under which the mission (use of the product) will be conducted, the higher will be the probability of a successful mission.

"Since future mission requirements are specified today and frequently based on yesterday's experience, we find ourselves in a risky situation unless appropriate forward thinking is applied in the planning stage for the inevitably changing conditions.

"The success of a future mission depends on how well we use what we know, how well we observe what is still hard to see, and how well we listen to what cannot yet be heard."

In discussing civilian trucking industry requirements for RAM, he said industry's concern is to earn an acceptable profit whereas the military concern may be reduction of time and maintenance costs within budgetary goals but is primarily on mission accomplishment.

Two significant advances in the over-all automotive industry he said he was pleased to report are: (1) the upward trend from quality organization systems, which are primarily manufacturing oriented, to product reliability systems, which are total product-flow-system oriented, and (2) management's increased interest in reliability and availability.

"Product reliability is now being represented on the general management staff with the same managerial authority and status as sales, manufacturing and engineering. . . . Their efforts result in more effective action at all levels with the aid of the Product Reliability Approach. . . .

"In summary, I observe that in major automotive industry companies that can afford

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Army Science Conference . . .

(Continued from page 27)

the more sophisticated control and information systems, the importance of Product Reliability and Availability is being increasingly recognized and acted on, by management, with higher priority. . . . At the same time that product operating performance and endurance are reaching higher levels, I observe a continuing improving trend in reliability of truck industry products."

Formal presentations by the panel members were followed by an exchange of viewpoints on some of the salient points that were raised, and a question and answer session that stimulated lively audience participation.

MEDICAL R&D COMMAND EXHIBITS. The consensus of Army Science Conference participants appeared to be that the Army Medical Research and Development's customary exhibits of medical R&D achievements reached a new peak of excellence, in quantity as well as quality.

The exhibits filled a large section of the Thayer Hotel's substantially expanded and extensively redecorated conference room facilities, where the five concurrent sessions for technical presentations were held. In previous years the sessions were held in the U.S. Military Academy auditoriums and classrooms.

Included in the exhibits were displays of the water-jet lavager, termed the biggest advance in cleansing and treatment of serious wounds in the past 100 years; the new method of using biodegradable plates for fracture repair (the plates can be "time-tailored" to be absorbed during the healing process); a new type of eyeglass electrical anesthesia device developed in France by Dr. Amie Limoge and now being tested by the U.S. Army for major surgery.

Shown also were the use of Nitinol, described as the "metal with a memory" because it can be programed to assume any desired shape at a certain temperature, thereby making it ideal for many types of dental clasps; a new hydroscrub device that shortens the time of a surgeon for sterilizing his hands from 10 to 15 minutes to about 90 seconds; the ecology and wildlife on Carroll Island, a former 855-acre chemical test site used by Edgewood Arsenal; and displays of the nutrient requirements of the adult human, based on studies at Fitzsimons Army General Hospital in Denver, Colo.

CSC Selects Army Employes for EPM Program

Five Department of the Army civilians were recently selected by the U.S. Civil Service Commission to participate in the 1972–73 Education for Public Management (EPM) program. One has since withdrawn because of illness.

An outgrowth of the Career Education Awards program initiated in 1962 under the National Institute of Public Affairs, the present program is used by federal departments and agencies as a part of executive development efforts. The Civil Service Commission assumed primary responsibility for the program in 1969.

Candidates are carefully selected to attend one of the nine participating universities for an academic year. At each school a core seminar is conducted for participants who also carry out individual study plans. This year's DA selectees are:

Albert D. Raspberry, supervisory chemist at the U.S. Army Aeronautical Depot Maintenance Center, Corpus Christi, Tex., who will attend Indiana University.

Since 1965, Indiana University has offered a special program of training and advanced study for mid-career public officials in the interactions of science, technology and public affairs. The purpose is to help the individual strengthen his capacity to cope with the public problems of a techno-scientific society.

Dean C. Stewart, contract specialist with the U.S. Army Aviation Systems Command, St. Louis, Mo., will attend the University of Virginia. There the purpose of the EPM program is to assist men and women who have demonstrated unusual capacity in several years of government service to prepare for higher positions of administration and policy leadership.

Mid-career participants at Virginia work closely with a program director who conducts a special seminar for the group, advises individuals about the remainder of their programs, and performs various administrative and counseling functions.

John D. Danielewicz, procurement analyst, U.S. Army Tank-Automotive Command, Warren, Mich., will attend the Massachusetts Institute of Technology.

The MIT program is designed to give mature, experienced employes of federal agencies intensive training and practice in systematic analysis of public policy issues.

Some of the special MIT subjects available only to members of the program are: Introduction to Systematic Analysis, Decision Analysis, and Application of Economics to Policy Analysis.

Mount L. Warren, chief of the Force Development Division, HQ, U.S. Army Ryukyus, will attend Stanford University, where the EPM has two components. One is designed to provide a background of professional expertise to persons who will eventually occupy executive positions of broad responsibility in public agencies. The second is devoted exclusively to systems analysis.

This year the Civil Service Commission is incorporating the Educational Program in Systems Analysis into the EPM program. EPSA was originally established to train analysts to develop systems for public program analysis.

Other universities participating in the EPM program are Cornell, Harvard, Princeton, Southern California and Washington.

Engineers' Society Cites AVSCOM

The U.S. Army Aviation Systems Command (AVSCOM), St. Louis, Mo., was honored recently with the Government Professional Development Award for Missouri—1972, presented by the Missouri Society of Professional Engineers.

AVSCOM was a dual winner, sharing honors with the Engineering and Construction Agency, Regional Office Facilities, U.S. Department of Health, Education and Welfare, Kansas City, Mo. A meeting in August will decide which of the dual winners will be entered in the national competition. The national winner will be announced in January.

In 1969, AVSCOM received a similar award, marking the first time the St. Louis chapter of the Society of Professional Engineers had so honored a federal agency. Competitors for the award are judged in eight categories covering Federal Government professional engineering employment practices.

HDL Patents Attest to Emphasis on Creativity

Working under the challenge of an inventive environment is part of the productive stimulous shared by employes of the Army's Harry Diamond Laboratories, Washington, D.C., as attested by 19 recent patent awards.

In recent years, HDL employes have maintained an average of receiving about 15 percent of all patents awarded to the U.S. Army, and about 4 percent of all patents issued to employes of U.S. Government agencies.

In the absence of HDL Technical Director Billy M. Horton, Associate TD Dr. Maurice Apstein presided at the patent awards ceremony.

Dr. Colin S. Willett, physicist, and Allen B. Holmes, mechanical engineer, each received two awards—Willett for "Sputtered Vapor Laser" and "Method and Apparatus for Obtaining High-Resolution X-Ray Interference Patterns"; Holmes for "Shock Wave Sensor" and "Diverter Valve Flow Throttle." Other awards were:

Dr. Apstein and George Keehn, an electronic engineer, "Bomb Fuzing System"; Dr. Helmut Sommer, an associate technical director, and James Salerno, physical science administrator, "Radar Target Identification System"; Robert B. Reams Jr., photographic technologist, and Charles H. Klute, chemists, "Optical System for Intermixing Dissimilar Step and Repeat Patterns."

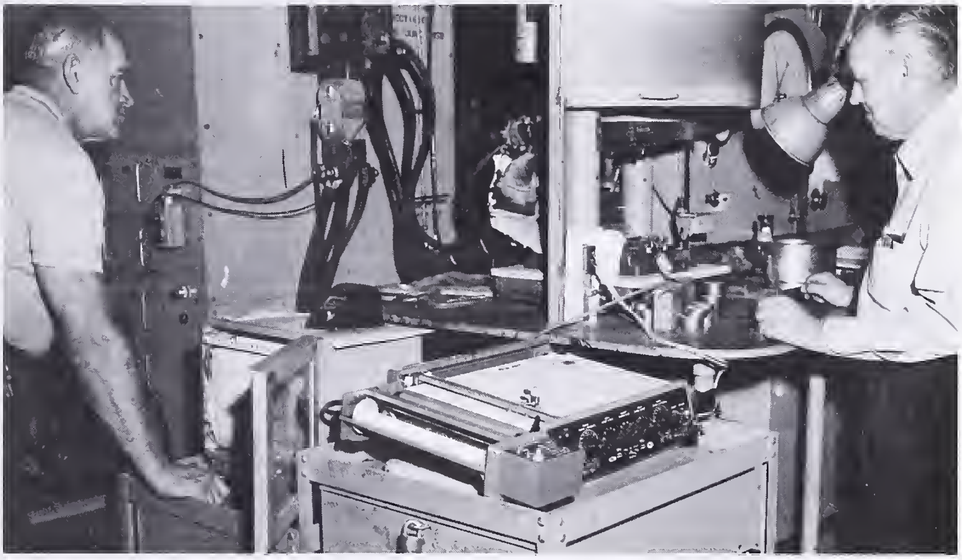
Also, Harlan J. Oelke, electronic engineer, "Nuclear Hard Video Amplifier"; Howard S. Jones Jr., physical scientist, "Dual Waveguide Horn Antenna"; John F. Burke, mechanical engineer technician, "Antishock Spin Device"; Carl J. Campagnuolo, physicist, "Pneumatic Frequency Comparator and Transducer"; Richard N. Johnson, electronic engineer, "Pure Fluid Display"; Raymond H. Femenias, electronic engineer, "Modulation Correlated FM Ranging System."

Also, Frederick W. Flad, physicist, "Integrated Timer and Nonvolatile Memory"; Herbert D. Curchack, physical scientist, "Linear and Angular Velocity Brake"; Charles W. H. Barnett, ceramic engineer, "Composite Shell with Ceramic Base"; Timothy J. Kilduff, chemist, "Reserve Battery Electrodes Using Bonded Active Materials"; and Allan M. Biggar, general engineer, "Centrifugally Operated S&A Device."

Resistance Sintering . . .

Army Materials and Mechanics Research Center Reports on Low Heat Consolidation of Powders

By W. J. Croft and L. A. Shepard



Instrumentation and Press Impulse Resistance Sintering

Resistance Sintering is a new powder consolidation process that shows promise of reducing costs and increasing productivity of hot-pressed components for the Army.

A high-amperage, low-voltage current is fed directly through the powder which is compacted between graphite plungers. The initial sintering rate is very high because the large current densities at the powder particle contacts causes tremendous power losses, and intense local heating.

Because the required pressures are low, the tooling (graphite plungers and die) is light and inexpensive, and relatively little energy goes into heating the die. Densification to 90 percent of theoretical is complete in a few minutes. The finished component may be removed from the die shortly thereafter. The low heat capacity of the plungers and die and the water cooling at the electrical input to the plungers facilitate rapid cooling.

A complete run of 15 minutes is a typical time to sinter a 2-inch diameter, quarter-inch thick sample of titanium monoboride. The sample was heated with a current density of 800 amperes per square inch for the first six minutes of this time.

The titanium monoboride, which is prepared by the reaction between titanium metal powder and titanium diboride, is a dense, very hard product that may be suitable for use in several military applications.

The one requirement for resistance sintering, of course, is that the powder be conductive. Conductive ceramics (metal borides and carbides) are readily densified by this process, even in cases where the conductivity is quite low. For example, boron carbide disks were prepared by resistance sintering.

Nonconducting ceramic powders can be densified by resistance sintering if they are coated with a conductive metal layer by evaporation, precipitation or chemical vapor deposition. Preferably, the metal addition should react with the ceramic or be dissolved in the densified material so that the minor sintering addition does not affect the properties.

For example, it was found in the present work that evaporating a small amount of titanium on boron carbide powder reduced the sintering time and the power input for equal densification from 7 minutes at 16.8 kilowatts to 4 minutes at 9 kilowatts.

Resistance sintering process offers promise for dealing with reactive powders without an elaborate protective atmosphere. The short sintering time and the reducing atmosphere produced by the hot graphite both favor the reduction of atmospheric contamination. The process shows possibility of being useful in the rapid and relatively inexpensive production of small parts.

DR. WILLIAM J. CROFT has worked on various aspects of solid-state chemistry, including the titanium-boron reaction, since joining the U.S. Army Materials and Mechanics Research Center (AMMRC) in 1969. He graduated from Columbia University with BS and MA degrees in minerology and received a PhD in crystallography in 1954. Prior to employment at AMMRC, he was a technical staff senior member, Sperry Rand Research Center.

DR. LAWRENCE J. SHEPARD has been engaged in research on sintered powder and composite materials and has contributed to armor and munitions programs at AMMRC since 1969. Dr. Croft received his undergraduate and graduate training in metallurgy at the University of California, Berkeley. He served on the faculty and staff at MIT (1959–69), working in mechanical properties of composites. He has authored over 20 publications.

ASC Keynoter:

LTG Gribble Presents His Viewpoints Regarding 'Changing Trends in Research and Development'

In presenting the keynote address at the eighth U.S. Army Science Conference, Army Chief of Research and Development LTG William C. Gribble Jr. opened with a tribute to his alma mater, the United States Military Academy, for continued excellence of support as host to each of the conferences.

The purpose of the conferences, he noted, has remained constant:

- To recognize outstanding achievement in Army R&D.
- To encourage exchange of scientific information.
- To encourage increased rapport among Army scientists from different in-house laboratories.
- To encourage exchange with "our sister services and our allies who are so well represented here today." (The Republic of West Germany and France participated for the first time, joining the United Kingdom, Canada and Australia in sending high-ranking defense officials as participants.)

Against the backdrop of a story about a man who had lived to be 100 years old and was asked on his birthday about changing trends during his time—"Well, I wasn't against them all!"—LTG Gribble then commented on the theme of the conference: Changing Trends in Research and Development.

"I am confident," he said, "that the attitude of our story's old man does not reflect the mood of this conference. We must constantly be aware of the patterns of trend and change in society. We should not only adapt the best to our needs but in many areas, such as R&D, we should be trend-setters and creators and users of change." The remainder of his address follows verbatim.

* * *

The identification of trends affecting Army Research, Development, Test and Evaluation (RDT&E) is not easy. Day-to-day operations often blind us to what is happening week-to-week and month-to-month. Year-to-year trends are most always overlooked unless a real effort is made to make comparisons.

In late November of 1971, I sent a memorandum to the directors and separate office chiefs of my staff, urging them to "examine trends—internal trends as well as national trends—before recommending a course of action to insure that all implications are understood and that the direction proposed considers fully those implications." As a result of that memorandum, I received many trend analyses and comments, some of which I would like to share with you today.

The trends in Defense research and development are exemplified by Secretary of Defense Laird's guidance to the military service secretaries for the formulation of the 5-year R&D program. His guidance was published in a memorandum in April of this year.

His memo addresses the importance of seeking greater productivity in our development and engineering work. In particular, he stresses the need for designing to realistic production and unit operating cost goals.

Of particular significance to us gathered here, he recognizes the need to reorient and increase our basic research and applied research, to revitalize our technological base, if we are to attain those goals.

We should and do have justifiable pride in the fact that the Army's research and development efforts have resulted in major innovations in producing equipment for a modern army. Such examples as tank/antitank systems (TOW and Dragon), surface-to-surface missile systems (Lance), and surface-to-air missile systems (Improved Hawk and SAM-D) are well known to you.

There are other technological areas, however, where we have just begun to scratch the surface in developing equipment that will expand our combat force capabilities, such as:

- The ability to conduct operations continuously day and night.
- Relative freedom from the traditional constraints of weather and terrain.
- Improved capabilities in obtaining battlefield intelligence in real time.
- The ability to deliver firepower support with considerably greater accuracy.
- The capability of improving our command and control of tactical forces.
- The opportunity for employing electronic cover and deception techniques, which are apparent but not yet realized.

We must continue to develop the world's best and most technologically superior weapons and equipment. To do so, we recognize the necessity to maintain a productive bank of scientific and technological knowledge that eventually can be exploited and utilized in improving the effectiveness of our security forces.

In this era of scientific expansion, we must and will keep replenishing and revitalizing the knowledge in this bank. This is somewhat analogous to an individual savings account—it should be available when needed, if it doesn't exist when needed, it is too late to start saving.

In recent years priority of effort had to be given to the development of weapons and equipment that offered answers to urgent Vietnam requirements. In doing so, we drew heavily on the technology base, simultaneously decreasing our ability to pay for replenishment. *It is this base we are hoping to replenish for the future.*

Let me expand a little on the meaning of the technology base. *Research* is a first step in providing a technology base:

- It provides the store of knowledge from which future military weapons and equipment emerge.
- It provides the information that enables us to evaluate properly contractor proposals, and to understand and evaluate foreign technical intelligence.
- Most importantly, it enables us to make confident decisions about future weapons systems.

Exploratory development, the other half of the technology base, has several clearly recognizable short-term and long-term goals. For the short term, it attempts to sustain the momentum of R&D activities toward orderly progress in the state-of-the-art. It also satisfies the preliminary need to investigate new techniques, and to examine the technical feasibility of a concept. subsystem or component.

The size of our research and exploratory development programs in terms of the purchasing power of our budget dollars has been relatively constant over the past few years at the level of about $300 million. Approximately 70 percent of that program is performed in our own laboratories—30 percent by contract.

The professional military and civilian personnel in the Army R&D community have been declining in number but improving in quality. We have 6,000 fewer people in our laboratories and R&D centers than we did in 1968, yet more scientific papers are being published than in 1968. The average age of our scientific and engineering personnel has remained at 42 years.

Under the terms of Secretary Laird's directive and considering the mood of the Congress, I would expect to see a continuation of these trends, but at a slower rate.

Before turning to national trends affecting research and development, I would like to address laboratory management for a few minutes.

You may have asked yourself several times during this presentation: How does Mr. Laird expect to increase R&D productivity without increasing the size of our budget? Or how valid are the indicators which show an increase in laboratory products despite reductions in laboratory personnel?

I admit the statements may appear anomalous, but I maintain they are true and are made possible by management.

The Army has endorsed the philosophy, at least since 1965, that a laboratory director should be authorized to exercise a great deal of autonomy in structuring his program, establishing and adjusting his goals, and in selecting his staff.

Three major management tools have been helpful in establishing a well-defined trend in the direction of decentralized laboratory management.

The first is the Independent Laboratory Director's Fund, with which the Independent Laboratory In-house Research (ILIR) Program was established in 1962. The fund now has 42 laboratories participating and has been a major influence in attracting and retaining outstanding researchers in Army labs.

The second is Project REFLEX, in which a test sample of four Army labs was selected to be given considerable latitude in the management of laboratory personnel. The experiences of all four labs have convinced us all that the principle should be extended to 12 additional labs in the forthcoming year.

The third tool is single program element funding, which permits a lab director to utilize his exploratory development resources in a highly flexible manner.

(Continued on page 32)

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Scenes at 8th Army Science Conference

(1) PANEL MEMBERS Dr. M. Shooman, Polytechnic Institute of Brooklyn; S. J. Miller GE Co.; H. N. Stuverude, Boeing Vertol Division, Boeing Center; Moderator J. I. Hope, Office of Science & Technology, Executive Office of the President; T. E. Battle, International Harvester Co.; LTG W. W. Vaughan, deputy CG, AMC. (2) ASC project officers LTC W. King, OCRD, and MAJ W. Sexton, USMA. (3) BG J. R. Jannerone, dean of the Academic Board, USMA; COL G. S. Webb, USMA Chief of Staff, & Mrs. Webb; Secretary of the Army Froehlke; Mrs. & Dr. Richard L. Haley, OCRD. (4) LTG W. W. Vaughan, deputy CG, AMC; Mrs. R. D. Dillaway, wife of the AMC Deputy for Laboratories; Mrs. R. O. Blake, wife of the Deputy Chief, Canadian Defence Research Staff; Mrs. J. Brinkman, wife of the director of RD&E, HQ WECOM; Secretary of the Army Froehlke & Mrs. Froehlke. (5) W. Wilson, HQ MASSTER; L. E. Link, WES; P. F. Carlton, OCE; Dr. G. Bushey, AMC; Dr. R. G. Buser, ECOM; L. M. Taylor, AMC. (6) Mrs. & COL D. W. Einsel Jr., Commander, Harry Diamond Labs; Mrs. John R. Jannerone; COL K. R. Ebner, OCRD; Mrs. O. P. Bruno, wife of the chief, Reliability & Maintenance Division, AMSSA.

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LTG Gribble Presents His Viewpoints Regarding 'Changing Trends in Research and Development'

(Continued from page 30)

The labs at the Missile Command pioneered this concept in 1970 and have set an inspiring example for the four additional labs that will employ the principle in the forthcoming fiscal year.

I am most anxious to encourage the trend toward improved lab management by selective decentralization of authority.

Not only am I interested in keeping our in-house laboratories strong, I am also interested in strengthening and increasing the positive trend toward increased cooperation with the scientific community. There are many civilian panels and committees with which the Army community maintains varying degrees of contact.

The Army enjoys fine relationships with and has derived much benefit from the President's Science Advisory Committee, the Defense Science Board, the Army Scientific Advisory Panel, and the host of eminent consultants available to those groups.

During the past few years, our relationship with these scientific advisory panels has significantly improved. In return, we have gained a considerable degree of increased interest in our efforts—improved support from the scientific community, confidence and respect from the over-all civilian community, and a significant number of worthy proposals to help us accomplish our mission.

I believe that we must continue to increase our interest and association with the scientific community by all profitable means, including presentation of papers and attendance at appropriate technical society meetings.

So much for internal trends. In examining national trends, and indirectly international trends, there are many facets that impact on the Army R&D effort. I could address drugs, the Modern Volunteer Army, ecology, the Nixon Doctrine, personnel turbulence, the over-all management of human resources, relevance of basic research to the Army mission, and such increasingly important topics as technology transfer and technology assessment.

Some of these subjects will be discussed by the Secretary of the Army during his banquet address. I will limit my remarks to relevance, technology transfer and technology assessment.

The 1969 Mansfield Amendment concerning military research relevance started a trend that has caused a number of side reactions.

(Continued on page 34)

Memo Delineates Systems Acquisition Policies

(Continued from page 23)

required systems demand a small first production by the developer to demonstrate reliability, maintainability, cost, and utility. Any competition subsequent to the first lot would then be based on a technical data package validated by final DT/OT.

In order to assure that funds are available to pursue the program as noted above, they must be budgeted in the appropriate fiscal year assuming success. They will not be obligated until approved at the various points noted above.

4. *Funding Priorities.* Within the RDTE appropriation, the Army must fully fund its top-priority projects so that development time is not lengthened for reasons of meager or marginal funding. This requires that lower-priority demands on RDTE funds must be regarded as potential trade-offs for funding support of the Army's designated high priority systems. The highest priority for exploratory and advanced development funding should be for components and subsystems of future systems that have been identified by the ROC approval process.

5. *Cost versus Quantity.* When there is a requirement for sophisticated equipment in order to provide a measure of superiority on the battlefield, it will prove to be expensive and complex. Therefore, the Army must, from the outset, explain the costs in terms of required effectiveness for all or part of the forces in terms of realistic contingency missions. If warranted, we should be prepared to make small buys of critical systems for only part of the total force, accept the high unit cost, and explain it well in advance to OSD and then to the Congress.

6. *Program Cost Control.* The success of a program is the function not only of our ability of acquiring a system that meets desired technical performance objectives within planned budgets. Excessive cost growth has been a major factor in the cancellation or cutbacks of past programs by OSD and Congress.

Extreme care must be exercised to insure that cost estimates realistically represent the acquisition cost of the system and that meaningful cost control over the acquisition process is maintained. Realistic cost estimates are essential for making proper system analyses and timely trade-off decisions.

a. During concept formulation, initial cost estimates are based on rather broad outlines of the system and parametric cost data obtained from other similar programs. Since cost growth experience is included in the parametric cost data, the resulting estimate may exceed other estimates being used for control purposes. Cost effectiveness studies and trade-off analyses during concept formulation will be based on the best estimate of the ultimate cost of the system. However, the program managers will be responsible for managing their programs against the approved program budget rather than the parametric cost estimates.

b. Control of development costs must include consideration of the full cost effect of technical changes. In managing within development program cost goals or budgets, the managers must be prepared to consider trade-offs involving performance within primary bands, secondary characteristics, and the related savings, and should also consider the trade-off of development schedules (IOC) and production and operating costs.

Proper consideration of production costs during development will require that "Design to Production Unit Cost" goals be established no later than entry into full-scale development. Such estimates will be stated in contractual documents as "design to" goals.

HumRRO Examines Flight Training To Evaluate Synthetic Flight System

One phase of an innovative flight training program, its development, and initial administration is described in Human Resources Research Organization (HumRRO) Professional Paper 7–72.

The operational suitability test activities related to a determination of the transfer of instrument training value of the Army's Synthetic Flight Training System (SFTS) Device 2B24. This paper was presented at the Fifth Naval Training Device Center and Industry Conference in Orlando, Fla.

Sixteen active Army members of an Officer Rotary Wing Aviator Course who had completed primary training and nine instructor pilots participated in the study. Copies of the report are available from: HumRRO, 300 North Washington St., Alexandria, Va. 22314.

CSC Approves New System For Classifying Positions

A project directed toward improvement and modernization of the system for classifying nearly 1.3 million (white collar) Federal positions at grades GS-1 through GS-15 has been approved by the Civil Service Commission (CSC).

Targeted for completion in the fall of 1973, the system being developed is fairly common in private industry. It embraces a factor-ranking approach with benchmark position descriptions. The CSC project will be carried out in three phases: designing a system, testing it, and evaluating results.

In phase one, panels of CSC and federal agency personnel specialists and managers will review a representative sampling of approximately 150 common jobs in various occupations to select and test tentative gradation factors. These will range from beginning level clerical work to high levels of professional responsibility.

Next, the commission will analyze results of the panels' studies, using computer processing to derive numerical weights for each of the factors to be used in measuring jobs, such as difficulty of work, amount of personal contact required in the job, knowledge required, and others. Conversion charts will be developed to translate the factor points into grades GS-1 through GS-15.

In phase two, the tentative system will be tested. Additional benchmark position descriptions will be prepared for use by agencies in evaluating a large sampling of jobs in their own agencies. Commission and agency specialists will audit the jobs evaluated by agency classifiers to test the accuracy of their decisions.

Finally, in phase three, the Commission will review and evaluate all data received during the test period. If the proposed method of classifying positions meets with the success anticipated, CSC and agencies will establish additional projects to implement the system.

Scenes at 1972 Army Science Conference

FOREIGN NATION participants entertained at a luncheon by U.S. Army Chief of R&D LTG William C. Gribble Jr. included (from left) Elgar Treharne, Defense Science attache, Australian Embassy; COL Marc A. Cauchie, deputy director for International Cooperation, French Ministry of Defense; Dr. Norman J. B. Wiggin, deputy chairman, Defence Research Board, Canada; LTG Gribble; BG Hans Ludwig Eberhard, head of the Technology Division, Ministry of Defense, Federal Republic of Germany; David Cardwell, director of the Military Vehicles and Engineering Establishment, Ministry of Defense, United Kingdom; Dr. Heinz Damm, Defense Research attache, Germany.

AUSTRALIAN REPRESENTATIVES (from left) Dr. Laurence Murray Gillin, Defense R&D attache, Australia; Elgar Treharne, Defense Science attache, Australian Embassy; LTC John W. Morphett, Australian Army Staff, Australian Embassy, Washington, D.C.; Wing Commander Allan F. Stewart, senior engineer and staff officer, Australian Embassy.

Shown (from left) are MAJ Christian Marchand, assistant military attache, French Embassy; Dr. Marvin E. Lasser, chief scientist, OCRD; LTG William A. Knowlton, U.S. Military Academy superintendent; Dr. Jacob B. Gilstein, director, U.S. Army Advanced Ballistic Missile Defense Agency, Brigadier Frederick Ward, director, Munitions Group and assistant Defence attache, British Embassy; Dr. Robert B. Dillaway, deputy for laboratories, Headquarters of the U.S. Army Materiel Command.

CANADIAN DELEGATION (from left) included Robert L. Baglow, director of Logistics Analysis, Defence Research Establishment (DRE); Dr. Henri P. Tardif, director, Armaments Division, DRE; LTC John F. Preston, Canadian Defence Liaison Staff, Washington, D.C.; Dr. Jack Wiggin, deputy chairman, Scientific Defence Research Board; Ben O. Baker, chief of Canadian Defence Research Staff, Washington, D.C., and Richard O. Blake, deputy chief; Sydney Wood, chief, General Engineering, Directorate of Clothing and General Engineering, Department of National Defence.

SOCIAL HOUR GROUP (from left) Fred H. Brauner, German Embassy, Washington, D.C.; Mrs. and Mr. John Strozyk, research physicist and author of ASC paper, U.S. Army Electronics Command, Fort Monmouth, N.J.; Mrs. and CPT Jesse Moss, author of ASC paper, USMA.

$1,000, Dr. Siple Award Technical Paper

TITLE: A Vaccine Against Organophosphorus Poisoning
AUTHORS: STERNBERGER, SIM, KAVANAGH, CUCULIS, MEYER, LENZ and HINTON
Edgewood Arsenal

ABSTRACT: Coupling of reduced diazotized organophosphorus agent E600 (paranitrophenyldiethylphosphate) into hemocyanine or aggregated bovine gamma globulin produced a vaccine which regularly evoked high levels of antibody in rabbits upon 3 to 4 intravenous injections. Specific protection aginst repeated intramuscular injections of 2 to 4 LD50's of agent was effective for 26 days. Protection waned 150 days after immunization. In contrast to prophylaxis by oxime and atropine, immune protection kept rabbits symptomless when exposed to agent. ItT anti-E600 had high association constants with E600 and low heterogeneity indices. In contrast purified anti-E600 had low association constants and high heterogeneity indices. With the effectiveness of the immunization approach assured it has become important to ascertain safety of the vaccine on large scale use. Safety increases with a decrease of the protein antigenicity relative to the agent antigenicity in the agent protein vaccine. Both antigenicities are recognized by different immunocompetent cells. The separate monitoring of each requires a sensitive quantitative immunoelectron microscopic method for enumeration of single cell receptor molecules. To this end the unlabeled-antibody enzyme method of immunohistochemistry was developed and quantitated. Immunization against organophosphorus agents provides the first instance that a vaccine against a synthetic poison has been pharmacologically effective.

$500 Award Technical Papers

TITLE: Restoration of Drug-Resistant Bacteria to Sensitivity to Chemotherapeutic Drugs
AUTHORS: HAHN and CIAK
Walter Reed Army Institute of Research

ABSTRACT: Bacterial diseases caused by drug-resistant organisms present major problems in military medicine. Clinical (foremost quinacrine) as well as experimental pharmaceuticals and dyes restored drug-resistant bacteria to sensitivity to chemotherapeutic drugs when this resistance was caused by episomal R-factors. This was first shown in model experiments with Escherichia coli and subsequently with pathogenic Klebsiella pneumoniae and, especially, with Salmonella typhimurium. Maximally, more than 95 per cent of cells of S. typhimurium regained sensitivity to the antibiotic drug, kanamycin, when grown in the presence of ethidium bromide. The mechanism underlying the elimination of resistance determinants is the formation of complexes of active compounds with R-factor DNA followed by selective inhibition of its replication. Since R-factor DNA is closed circular in its molecular architecture, the eliminating compounds act not only by stabilizing double-helical DNA to strand separation (which is a prerequisite to DNA replication) but also wind up the DNA circles into artificial supercoils whose biochemical functionality is suspended. Our experimental elimination of bacterial drug resistance suggests the feasibility of undertaking an R&D program with the objective of developing superior drug sensitivity-restoring pharmaceuticals to be administered to patients along with chemotherapeutic drugs for the clinical cure of bacterial infections with drug-resistant organisms.

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TITLE: A Theoretical and Experimental Investigation of Flap-Lag Stability of Hingeless Helicopter Rotor Blades
AUTHORS: ORMISTON and BOUSMAN
US Army Air Mobility R&D Laboratory, Moffett Field

ABSTRACT: The hingeless rotor holds considerable promise for improving future rotary wing aircraft. Development of this concept however, has been complicated by a number of unpredicted rotor blade instabilities occurring on sveral aircraft, notably including the AH-56A. These instabilities can be attributed largely to the lack of basic research on hingeless rotors. The present theoretical study was therefore undertaken to provide a basic understanding of this problem. Only the

(Continued on page 36)

CRD Presents Viewpoints On Changing R&D Trends

(Continued from page 32)

National criticism of science and technology and campus revolt against military research were catalyzed by this amendment.

Although conditions have calmed down, two important trends still remain. One is that a schism has been created between research supported by the Army and that supported by the National Science Foundation. The impact of this polarization is still in the process of evolution.

The other by-product of relevance is the establishment of a result-oriented attitude towards military research. Goals and objectives for military research now have to be carefully defined.

The need for forecasting the direct output or by-products of investigations for a few to several years into the future has established a trend in itself. I expect this trend will continue, although not with as great an emphasis as during the early days of the Mansfield Amendment.

Science and Technology, as you so well know, are involved with society in many ways. There is a broad spectrum of relations—philosophic, social and ethical—by which science and technology influence and are influenced by society.

This significance is becoming more evident

Dr. F. E. Hahn

W. Bousman & R. Ormiston

in the numerous aspects in which science and technology interact with the affairs of men. An aspect which is becoming more prominent daily is the demand from many sectors of society for the coupling of science and technology to solving the major problems of American society.

Over the years there has been an increasing ground swell, particularly in the civilian community and to a lesser extent in the military community, to develop a means for transferring military science and technology to the civil sector.

This concept received official recognition several years ago from Clark Clifford, Secretary of Defense, who made the public suggestion that Department of Defense laboratories should also turn their attention to problems in the civilian economy.

Other federal agencies are now actively engaged in the transfer of their technological effort to the civilian economy. The primary example, of course, is the National Aeronautics and Space Administration. Until very recently NASA spent as much as $10 million annually in what was called the Technology Utilization Program (TUP). Directed by Congress to set up its TUP by statute, NASA has had considerable popular and Congressional support.

To date, the Army's R&D has been relatively sacrosanct in being able to sustain itself on military necessity alone. But times are changing.

In a Washington news dispatch, the *New York Times* recently reported, and I quote:

"The National Research Council, the operating arm of the Nation's most prestigious scientific group, is to be totally reorganized so that it can deal more effectively with the major problems of American society."

The General Accounting Office recently submitted a report to the Congress on "Means for Increasing the Use of Defense Technology to Meet Urgent Civilian Needs." The GAO recommended that the Department of Defense "Actively undertake active technology transfer efforts and interagency sharing of DoD resources."

The National Science Foundation has a new $80 million program called RANN—Research Applied to National Needs. Congressman Roush has introduced a bill to establish an Office for Federal Technology Transfer.

The Federal Council for Science and Technology, under Dr. David, the President's Science Adviser, has called for using "Existing research and development capabilities in federal establishments effectively, to define and solve technological problems relating to some of the urgent civilian needs."

Mr. Laird is expected to sign a memorandum encouraging the Services to participate and cooperate with civilian agencies desirous of exploiting the technological expertise which exists in DoD laboratories.

The trend is obvious. Although we have contributed over the years, it is abundantly clear that we will be called upon more and more to help the civil sector solve its pressing problems. We can and must do this, but without interfering with our primary military mission.

The last topic I would like to mention is technology assessment. Although I do not feel that at the moment this is as pressing as technology transfer, technology assessment is here to stay. Sooner or later, we shall be deeply involved with as yet unknown consequences.

DR. PAUL A. SIPLE MEMORIAL MEDALLION winners from Edgewood (Md.) Arsenal at 1972 U.S. Army Science Conference assembled in his Pentagon office to receive Chief of R&D LTG William C. Gribble Jr.'s commendation and congratulations. From left (seated) are Dr. Van M. Sim, GEN Gribble and Dr. Ludwig A. Sternberger. Standing: John J. Cuculis, Dr. David A. Lenz, COL Joseph R. Blair, CO of the Edgewood Biomedical Laboratory, Howard G. Meyer, Dr. Benjamin L. Harris, technical director of the Biomedical Laboratory, Dr. Dennis M. Hinton, and CPT William G. Kavanaugh. The winners shared $1,000 honorarium provided by the Army Incentive Awards Program.

In the past three to five years, a pronounced movement away from the traditional unquestioning acceptance of new technology has taken place. We are now seeing a better-informed, technically literate public, including Congress, taking part in a debate over the social effects of technology. The scientific community questions the expected uses of its discoveries. Emerging is a general reluctance to accept new technology without an analysis and discussion of its effect on the environment, consumers, labor, future generations, etc.

Reinforcing this trend are the increasing rate of complexity, the global scale of effects, and the increasingly complicated by-products (the unknown unknowns) of modern technology.

All these factors have led to a demand for more thorough, systematic analysis of technological advances, with attention to social as well as economic effects. This process is called technology assessment (T.A.). Environmental impact statements are a good example of T.A.

From the Army point of view, these emerging trends mean a continued narrowing of the range within which management decisions can be made. The past 25 years have produced a network of economic constraints developed to limit the effects of a laissez-faire economic system.

In the future, I expect to see more constraints on technology, similar to the web of economic legislation of the past few decades which effectively limited the free play of market forces. The end of what might be called the "Age of Laissez-Faire Technology" is approaching.

The legislative and administrative trend is becoming clear. With the passage of the Environmental Protection Act, there has been a steady stream of bills to create a technology assessment capability for the Congress. One of these bills has passed the House and seems on the way to easy passage in the Senate.

A best estimate of what this means for the Army is that, while decisions among technological alternatives have traditionally been made on the basis of probability of technical success, a new factor is in the offing—technology assessment.

If the trend toward consideration of the social and environmental effects of technological developments matures, then Army decision-makers will have to add a second criterion to the probability of technical success—potential or probable adverse social and/or environmental effects.

What the results of this will be is not clear at the present time. It may be that the Army will have to enter into a technology assessment and enforce a T.A. requirement in procurement and RDT&E contracts. The need for this will become clearer as time goes on.

Before closing, I would like to tell you about a noted speaker who delivered a long talk at a recent technical society meeting. After one hour on the podium, the speaker looked down to turn a page. Upon looking up, he noted that half his audience had disappeared. Completing the page, he again looked down to turn it. When he raised his eyes again, he found to his dismay that another quarter of the audience had disappeared. The process continued a few minutes more to the end of his talk, until only one man was left. The speaker's curiosity now being aroused, he asked the lone member of the audience why he too had not left. The reply was quite to the point: "Because I'm the last speaker."

With this in mind, and before I suffer a similar fate, let me again note with pleasure the outstanding attendance at this symposium, and wish you every success for a stimulating, challenging and fruitful conference.

$500 Award Technical Papers

(Continued from page 34)

essential flap and lead-lag degrees of freedom of a hovering rotor blade were retained to insure that important fundamental characteristics would be readily discernible.

The results of the analysis show that for certain design configurations the blade will become unstable due to inertial, aerodynamic, and elastic coupling of the flap and lead-lag degrees of freedom. The effect of elastic coupling, not revealed in previous work, was found to be highly stablizing or destablizing depending upon the amount present. Similar characteristics were also found for kinematic pitch-lag coupling.

These results are revealing because they illustrate how a lack of knowledge of these fundamental design parameters can easily lead to rotor blade instability. On the other hand, the results are promising because a full understanding will insure that the vehicle can be designed to be free from instability.

The experimental results obtained with a specially designed model rotor confim that the destabilizing aerodynamic and inertial flap-lag coupling occurs for actual rotors.

$350 Award Technical Papers

TITLE: Stability of Ammonium Nitrate as Inferred From Structural and Lattice-Dynamical Studies
AUTHORS: CHOI, IQBAL, PRASK and TREVINO
Picatinny Arsenal

ABSTRACT: Ammonium nitrate is a material of considerable interest because of its wide range of uses, which includes explosives. It is of fundamental scientific interest because not only does it readily decompose, but it also exhibits a vertually unique crystal phase instability. That is, it undergoes four distinct temperature dependent structural transitions in the solid phase, at atmospheric pressure. It is the correlation of microscopic properties (i.e. crystal structure, energy states, interatomic forces) with instability - both structural and chemical - to which the present work is addressed. Neutron diffraction has been used to determine, for the first time, the detailed crystal structure of NH_4NO_3(IV), the room-temperature stable form. This work, when examined with the incomplete structural data for the other forms, suggests why water plays an important role in inducing apparently anomalous microscopic behavior in ammonium nitrate. Coherent neutron inelastic scattering (CNIS), the most powerful spectroscopic technique available, has been used to examine vibrationalstate distributions in $NaNO_3$ for the first time, which provides some further insight into the behavior of NH_4NO_3. In conjunction with this latter effort, a method for obtaining selection rules for CNIS measurements has been derived which significantly enhances analysis capabilities for complex, moleculer crystals such as NH_4NO_3.

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TITLE: The Kinetics and Mechanism of the Binary GB Reaction as Determined by NMR Spectroscopy
AUTHORS: WINTERMYER, SZAFRANIEC, BRADFORD and KLAPPER
Edgewood Arsenal

ABSTRACT: The development of any flexible and sophisticated binary chemical weapon system requires the availability of a substantial quantity of information. The current study was undertaken in order to obtain definitive data concerning the Binary (promoted) GB reaction.

The kinetics of the binary reaction were determined using ^1H, ^{19}F and ^{31}P nuclear magnetic resonance spectroscopy (NMR) and a reasonable mechanism for the reaction was proposed. NMR was used to determine the suitability of various promoters and to evaluate some of the factors that might influence the rate of agent formation and the amount of agent formed.

(Continued on page 38)

ASAP Schedules Review Of Tactical Nuclear Weapons

Tactical nuclear weapons technology and applications will be considered by the U.S. Army Scientific Advisory Panel at its fall meeting, Oct. 30-31. Former panel chairman Dr. Harold M. Agnew, director of the Los Alamos (N. Mex.) Scientific Laboratory (LASL), will host the meeting.

Deputy Assistant Secretary of Defense (International Security Affairs) John H. Morse is programed as a featured speaker on the function of nuclear weapons, and why national strategists consider them necessary to the force structure of U.S. Military services.

Director of Plans BG Henry J. Schroeder Jr., Office of the Deputy Chief of Staff for Military Operations, is scheduled to speak on application of nuclear weapons to the military mission in Europe, and conventional alternatives.

Discussion of nuclear weapons will include some of the future concepts. The program also lists visits to the LASL, the weapons museum, the MESON facility, and facilities for plutonium and high energy fabrication. High-speed flash X-ray techniques for studying explosive processes also will be demonstrated.

S. F. Trevino & H. J. Prask

L. Szafraniec & H. Klapper

ASC Banquet Address:

Secretary of the Army Froehlke Discusses Impact Of Summit Conference, Budget, MVA, R&D Problems

Secretary of the Army Robert F. Froehlke opened his banquet address to Army Science Conference participants and their ladies with a tribute to Deputy and Scientific Director of Army Research Dr. Richard A. Weiss, as noted in the main article on the conference beginning on page 24. The main text of his address follows:

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"This is really quite an ecumenical meeting. We see civilian scientists with the military scientists, American scientists with the scientists from our allies (referring to the high-ranking defense leaders of the United Kingdom, France, the Republic of Germany, Canada and Australia).

"It is good to see people of diverse backgrounds representing diverse interests, all getting together in the interest of a Free World."

Commenting that he probably was "the most nontechnical Secretary of the Army that the Army has ever had," he said he was not about to try to give a scientific address. Secretary Froehlke termed the conference an indication "that you do appreciate the need for a strong Army in the United States of America, and that you do want to do your part to keep the Army strong and headed in the right direction. . . ."

Turning to the impact of the events resulting from President Nixon's recent summit conference in Moscow, he said the current question of concern to people in the research and development community is: "What is the impact on weapon systems, research and development, and the U.S. Army generally?"

Assuming that terms of the treaty will be ratified by Congress, he said the one certain impact is that the proposed construction of 12 Safeguard ABM defense sites will be reduced to two—one at Grand Forks, N.D., and a new site in the Washington, D.C. area. He added:

". . . However, and I think this is important from the standpoint of research and development, the treaty said nothing about doing advanced work in more sophisticated ballistic missile defense. . . .

"We will continue to go ahead with our efforts to have a prototype for site defense. We think it is most important that we have a very sophisticated defense.

"Now the more complicated, and I believe the more misunderstood aspect of the result of SALT (Strategic Arms Limitation Talks) is our interim agreement on offensive systems. This agreement, to last for five years, really is an agreement to agree to talk more, hopefully resulting in a treaty sometime in that 5-year period.

"There is a danger with this interim agreement. The danger is that euphoria will set in, particularly among our more politically inclined. They will say: 'Let us sit back; let us save money; let us relax. The milennium has arrived.' Mel Laird (Secretary of Defense) has made it very clear, in his testimony before Congress that that is not the stand of this government.

"We are very hopeful that a treaty will be agreed to within the 5-year period. Nevertheless, we believe it is very important to move ahead with the Trident submarine and the B-1 bomber and other R&D projects.

"Many people in the political arena will ask 'Why?' I suggest to you there are a number of reasons, but I will cite only three. However, to understand any of those three reasons you must be aware of a very simple and basic fact. No country, including the United States of America or the Soviet Union, will sign any treaty which that country feels is not in the best interests of that country.

"Therefore, it is important, if we want a treaty, to create a climate in which the signing of the treaty is the best option for both countries involved.

"The reasons that we must move ahead, under the terms of the interim agreement, with very rapid research and development are:

- We want to make sure that the Soviet Union continues with SALT on offensive systems in a sincere manner, and we believe, as long as we continue to move rapidly ahead, this will, hopefully, insure their sincerity.
- We hope that there will be a treaty signed during that 5-year period, and we believe that the more rapidly we move ahead with these offensive systems, the more likely a treaty will be signed.
- Nonetheless, let us not get carried away with euphoria. The treaty may not be signed. Perhaps the greatest danger of all is to find, after five years, that there is no treaty and that research and development have stood still during that period.

"For those reasons we believe that R&D in the strategic arena must continue, even though we do have an interim agreement for strategic offensive weapons. . . .

"I am one of those who believe that we are not going to have a nuclear catastrophe. I am confident because, at least in the forseeable future, we are going to have parity in the nuclear arena with the Soviet Union.

"I cannot contemplate any responsible leader starting a nuclear war under conditions of parity.

"Any historian will tell you, however, that hostilities among nations have existed since year one. Therefore, we must anticipate that hostilities will occur in the years ahead.

"If we have nuclear parity these hostilities are undoubtedly going to involve conventional weapons. Yet I see too much conversation among supposed responsible politicians saying that we no longer have to worry about conventional forces.

"I believe that with the Strategic Arms Limitation Talks and with parity in strategic weapons, the conventional forces take on increased importance. . . .

"I understand that today one or two of your speakers mentioned that there is somewhat of a dollar shortage when talking about our military budget. The availability of adequate funds—or the lack thereof—looms large over our activities.

"The amount of money the United States spends for defense should be a debatable subject. I think it is important that we do debate this subject, and certainly we are debating it. I also think it is terribly important in a debate to have the facts on the table—that all can begin from the same point.

"When we talk about dollars for defense, I am disturbed because too many of our citizens, including responsible politicians, don't know the facts. I don't want to bore you with statistics, but let me give you two examples.

"This country has had a substantial reordering of our national priorities in the last 3½ years. In 1968, 9.6 percent of the gross national product went for defense. This year it will be substantially below 7 percent.

"In 1968, 42.4 percent of the total federal budget went for defense. This year it will be under 32 percent. We should all agree there has been a substantial reduction.

"I happen to be in the group that says it should not go any lower. For those who say it should, I say to them: What commitment in this world should be crossed off, or what in the world climate do you see which causes you to say we should cut our defense spending even more?

"A further fact, that many ignore, is that in the last three years 2.7 million jobs, defense or defense-related jobs, have been cut. Clearly, that is a substantial reordering of our priorities—and properly so.

"Unfortunately, we have not done a sufficiently good job of articulating these facts to the American public. When you talk about dollars in this political year, many people, in every press conference I attend, ask:

" 'What do you think about the realism of cutting $30 billion from the defense budget?' Immediately, I reply by pointing out that, by direction of the President, I am not to become involved in a partisan debate, although I must confess that's a little difficult. Almost every issue that a Secretary of the Army deals with becomes a political issue during the political campaign.

"I quickly point out that I don't want to make any comment about individuals who are campaigning for the nomination for President. However, I make no bones about the fact in saying that if any President of the United States—and I distinguish between a candidate for President and the President—given the facts that exist today, cuts the defense budget by $30 billion, he is acting irresponsibly."

(Secretary Froehlke interjected into the above comment that, in distinguishing between a candidate and a President, two vital factors change when a man becomes President—(1) he has the responsibility of the office, and (2) he has the knowledge that goes with the office.)

Turning to the subject of research and development again, he discussed three things that "concern me . . . in the R&D field. One is what I hear every time I appear before Congress and before a sophisticated public audience.

"And that is the ratio of support troops to men in the combat arms. This allegation is continually made, that we are having more and more people assigned to the 'fat,' that is, the

(Continued on page 41)

Earth Resources Inventory . . .

Over 300 Investigators Participate in NASA Study, Including Army Engineers, Using Satellite Sensors

Man's "first comprehensive inventory of the natural resources required for survival" began July 23 with the maiden launching of a new satellite whose mission involves more than 300 principal investigators, including 30 data platforms of the U.S. Army Corps of Engineers.

Named Earth Resources Technology Satellite-A (ERTS-1 in orbit), the one-tone, electronic "pathfinder" lifted-off that date aboard a 2-stage Delta rocket from the Western Test Range, Lompoc, Calif. ERTS-A is a program of the Office of Applications, National Aeronautics and Space Administration (NASA).

From its outpost in space, some 907 kilometers (564 statute miles) high, the butterfly-shaped observatory will literally take "daily EKG's" (electrocardiograms) of the earth's health. ERTS-A's remote sensors include three Return Beam Vidicon (RBV) cameras and a Multispectral Scanner (MSS), expected to monitor the earth's natural resources more thoroughly, and completely, than ever before in mankind's history.

Aboard the 891-kilogram (1,965-pound) spacecraft is a Data Collection System (DCS) which receives environmental data of all types from small electronic remote platforms.

ERTS-A is termed a first step in the merger of space and remote sensing technologies into a system devoted to a more efficient management of the earth's resources. The imaging sensors will always be looking toward earth, collecting earth and not space data.

Principal purpose of the first ERTS-A mission is to determine what can be accomplished in remote sensing from an orbiting platform. The knowledge obtained will be used to determine the type of sensors, and the ground handling techniques, best suited for an operational earth survey program.

As an important part of this mission, the U.S. Army Corps of Engineers is conducting seven experimental projects to test the feasibility of collecting U.S. water resources information by utilizing the satellite now in orbit.

Corps of Engineers' researchers hope to obtain information and data on snow cover, precipitation, stream flow, sediment transport, eutrophication, beach erosion, changes in vegetation, water quality, detection of chemicals and solids, drainage and general characteristics of selected waterways.

The two imaging systems, RBV and MSS, and a radio relay system aboard the satellite are expected to provide multispectral imagery and data which the Corps will use in performing its water resources mission. Ground truth (measurements taken on the ground) and high-, medium-, and low-altitude aircraft remote-sensing information will be used to aid in the interpretation of the satellite imagery.

The experimental projects will provide data and imagery of the New England river basin areas, Chesapeake Bay, along the coastal areas of the Pacific Ocean in California, in the Cook Inlet area in Alaska, the Barrier Island off North Carolina, the Lower Mississippi Valley, and at the site of a proposed Corps reservoir in Illinois.

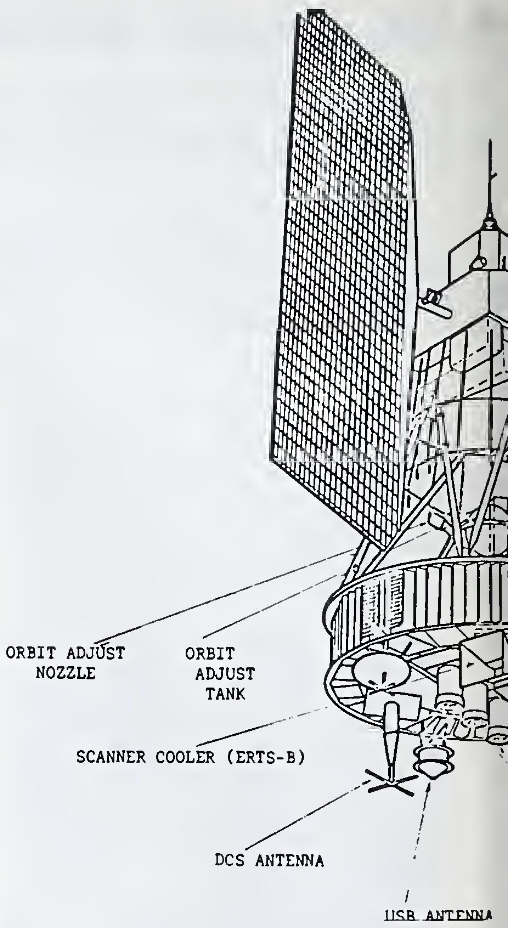
In the New England experiment, 25 data platforms will be placed along waterways from Stamford, Conn., to Fort Kent in northern Maine. They will collect data such as stream flow, precipitation, temperature, soil moisture, tide changes, snow depth and water quality.

Information will be transmitted twice daily to the satellite's data collection system which will relay it to a receiving computer at the Goddard Space Flight Center in Beltsville, Md. An interfacing computer at the New England Engineer Division at Waltham, Mass., will receive the relayed data almost simultaneously. This experiment will test the feasibility of using satellite data relay in lieu of expensive "hard wire" or microwave data collection systems.

Corps of Engineers investigators anticipate that the Chesapeake Bay studies, conducted by the Waterways Experiment Station (WES), Vicksburg, Miss., will provide information on how seasonal changes affect the water as the river mixes with the bay, changes that occur in vegetations, sediment movement, detection of solids and other foreign matter including chemicals, and other ecological changes in the area.

The Corps will also coordinate 11 investigations in the Chesapeake Bay area being conducted by six agencies. The Corps will organize the aircraft remote sensing of the area, the collection of ground truth data, and will enhance the flow of information among the investigators.

In other Corps of Engineers experiments, the Cold Regions Research and Engineering Laboratory, Hanover, N.H., will study ice cover, circulation patterns and sediment transport in Cook Inlet in Southern Alaska. The effects of steam rings and permafrost changes in the Fairbanks and Eagle Summit areas in Central Alaska will also be investigated.

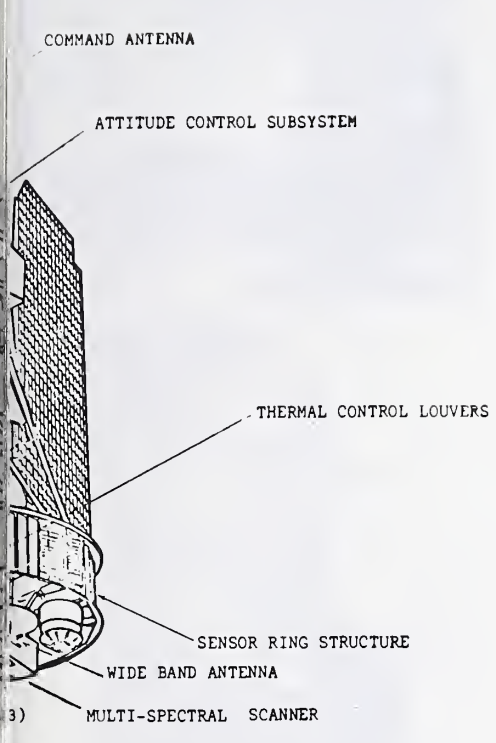


The Coastal Engineering Research Center, Washington, D.C., will study beach buildup and erosion as well as dune patterns of the Barrier Islands off North Carolina's Atlantic Coast.

The Waterways Experiment Station will have a second project in the Lower Mississippi Valley to study drainage and vegetation characteristics and to obtain data for flood plain mapping.

The South Pacific Division, Corps of Engineers, plans to monitor coastal processes around San Francisco Bay, Humbolt Bay, and the southern California coast from Morro Bay to Mission Bay. It will study sediment transport, estuarine exchange—the changes in estuaries where the rivers discharge into the bay—and the dispersion of chemical and biological wastes dumped into the waters flowing into the bay and the bay itself.

The U.S. Army Construction Engineering Research Laboratory (CERL), located near the campus of the University of Illinois at Champaign-Urbana, will evaluate the feasibility of monitoring the environmental impact and vegetation changes resulting from construction, filling, and operation of the Oakley Reser-



voir on the Sangamon River in Illinois.

ERTS-A is orbiting the earth 14 times a day. Each picture taken by the imaging systems shows 100 square nautical miles of the earth's surface. The satellite is expected to view the entire earth every 18 days.

In the scientific community, ERTS-A represents one of the most widely anticipated events of the space age, for the term "earth resources" has a much broader meaning than just valuable minerals and other deposits. It covers all the conditions on the earth's surface which are of economic, social and cultural interest to humanity.

The new space observatory could produce technological break-throughs in the fields of agriculture/forestry, geology, geography (land use management), hydrology, pollution, oceanography, and meteorology.

From a principal investigator's standpoint, the ERTS program represents the first of its kind for unmanned spacecraft. Unlike previous unmanned programs, in which each of the principal investigators had an experiment aboard the spacecraft, the ERTS experiments are furnished by NASA but the investigators will share in the scientific bounty.

The more than 300 investigators, the largest number ever approved for a space program, are from 44 states, the District of Columbia, and 34 foreign countries. NASA funds the domestic experiments while those from foreign countries are funded by the scientists' own country.

To handle this large group, NASA/Goddard Space Flight Center, Greenbelt, Md., has assigned 25 scientific monitors to analyze results submitted by each of the experimenters.

In broad terms, the ERTS-A objectives are:

- To take an inventory of the vegetation in forest, farm lands and grass lands.
- To measure the condition of the soil and its ability to store water so the movement of fresh water across the surface may be charted and floods predicted.
- To catalog surface rocks and mineral formations.
- To chart changes in ocean currents, sediment discharges in estuaries, ice-free lanes in northern regions and other phenomena in the oceans.
- To establish the sources and spread of pollution.
- To improve the mapping of the earth.

"The important thing to remember is that the coverage is repetitive," said Dr. William Nordberg, ERTS-A project scientist from NASA's Goddard Space Flight Center.

"Every 18 days we will have an opportunity for a complete survey of any part of earth which is cloud-free and we will then start over again. High-altitude aircraft have already aided us in charting interesting features of the earth. But regular, repetitive coverage as we anticipate from ERTS-A will hold even greater promise of continually charting our planet and its resources."

The ERTS-A design has been based on the technology of the highly successful series of Nimbus meteorological satellites which have established many "firsts" since Nimbus-1 was successfully launched Aug. 28, 1964.

The satellite will be capable of providing large volumes of information—like 15,000,000 bits of information per second. This is equivalent to an Encyclopedia Britannica every few mintues. As a contrast, ERTS-A's predecessor, Nimbus, provides about 18,000 bits of information per second.

The ERTS-A communications system for sending video pictures to earth uses improved flight equipment. While somewhat comparable to a home television set, it is much more sophisticated. Where commercial TV sends about 30 pictures per second, the high-information content of ERTS pictures requires about 25 seconds to send each set of pictures over a wideband communication link.

The ERTS-A sensors, and their associated communications and electronic equipment, weigh about 220 kilograms (485 pounds) but require only about as much power as a few light bulbs.

The methods of operation for the RBV and MSS differ. The RBV is actually a camera, although it does not carry any film. When the shutters of the three RBV cameras click, images are stored within each vidicon camera tube and then scanned to provide a video picture. The cameras are shuttered every 25 seconds to produce overlapping pictures of the ground scene below the satellite.

The MSS produces images by a process different from that used by the RBV, which lets a burst of light reach a photosensitive surface. The MSS forms an image by breaking a scene into many tiny segments and looking at each segment separately. The segments are exposed in rapid succession through a moving mirror in the optical system, so that the instrument is continuously scanning.

The end result of imagery from both systems is a black and white photograph in each of the seven bands, three bands for the RBV and four for the MSS. When the black and white photos from each of the bands, and each of the sensors, are put together they comprise a false color photograph.

Possibly ERTS-A's biggest asset will be its ability to photograph large areas in a short time with a resolution satisfactory for many scientific disciplines. For example, the spacecraft will take a picture of an area 185 × 185 kilometers (115 × 115 statute miles) in only 0.004 to 0.016 second.

Just one picture will cover an area of more than 34,000 square kilometers (about 13,000 square miles), a big attraction to mapmakers. The average resolution for ERTS-A sensors will be better than 100 meters (328 feet). The RBV cameras will take 188 pictures daily and the MSS will scan the same area. It will take about 500 photos to map the United States from ERTS-A versus 500,000 from aircraft.

Working with NASA on ERTS-A are federal agencies, state and local governments, foreign governments, industry and universities. Federal agencies involved are NASA, the Departments of Agriculture, Commerce, Interior and Navy, plus the Environmental Protection Agency and the U.S. Army Corps of Engineers.

What is the over-all significance of this project?

The answer comes from Dr. Robert N. Colwell, University of California at Berkeley, who is in charge of ERTS-A proposal No. 277, regional agriculture surveys, including forestry. He commented:

"I think ERTS-A will be the most important photographic mission in the history of man."

$250 Award Technical Papers

(Continued from page 36)

TITLE: Role of Water Jet Devices in Combat Surgery
AUTHORS: BHASKAR, GROSS and CUTRIGHT
US Army Institute of Dental Research

ABSTRACT: The immediate management of combat wounds presents a variety of problems. These include time consuming debridement procedures as well as the ever present possibility of infection and suppuration. The accepted methods of debridement consist of scrubbing the wounds with one of a variety of disinfectants and washing it with the conventional bulb syringe. These methods are slow and may in some instances be less than totally effective. A series of studies were therefore begun at the United States Army Institute of Dental Research in 1966 to improve the then used methods of the debridement of the combat wounds. The purpose of this paper is to present findings from a series of studies which led to the development of new instruments and techniques for the debridement of combat wounds. These techniques and instruments are currently used in combat zones and have been adopted for use in selected military and civilian hospitals.

COL A. Gross & BG S. M. Bhaskar

COL D. E. Cutright

TITLE: The Ring Airfoil Grenade
AUTHOR: FLATAU
Edgewood Arsenal

ABSTRACT: The purpose of the study was to determine the feasibility of utilizing a ring airfoil configuration in a munition form as the principal component of a shoulder-fired grenade system. This unique munition concept, known as the RAG (Ring Airfoil Grenade), is based on the generation of aerodynamic lift to retard the drop due to gravity. In conjunction with low drag shaping, the lift results in a relatively flat trajectory and a significant increase in range.

Wind tunnel testing, parametric investigations, and flight dynamics analyses provided a means of performance prediction and correlation with field test results. Terminal ballistic arena tests provided lethality data for evaluation of munition potential.

The study showed that the flight and munition characteristics of the RAG offer an unusual advance in the state-of-the-art and represents new potential for future weapon systems.

A. Flatau

TITLE: Shaped Charge Liner Collapse and Jet Formation-
Analytical and Experimental Investigations
AUTHORS: RANDERS-PEHRSON and KNUTELSKY
Picatinny Arsenal

ABSTRACT: A computer code of the Lagrangian type has been developed to analyze the collapse and jet formation of a shaped charge liner by solving the hydrodynamic equations in finite difference form. Rezoning and line elimination were incorporated into an interactive graphics package and added to the code to handle regions of extreme distortion. An ultrahighspeed streak camera was used to measure the velocity-time history of a number of elements of the liner of the BRL 105mm unconfined test charge. The results supported the computer predictions, and currently accepted jet formation theory was directly verified. Two important details of the collapse process were discovered which account for details of the mass distribution in the jet and may contribute to jet breakup.

G. Randers-Pehrson & B. G. Knutelsky

TITLE: A Novel Synthesis of HMX (1,3,5,7-Tetranitro-1,3,5,7-Tetrazacyclooctane)
AUTHORS: SIELE, WARMAN, LECCACORVI and GILBERT
Picatinny Arsenal

ABSTRACT: An important new synthesis of HMX has been developed, which uses the same raw materials as the existing HMX process. However, the chemistry of HMX formation is entirely different. The procedure

(Continued on page 41)

V. I. Siele & E. E. Gilbert

Froehlke Discusses Impact Of Summit Conference, Budget, MVA, R&D Problems

(Continued from page 37)

support element of the Army, and fewer and fewer are out carrying rifles.

"I want you to know what my answer is. I readily admit this is true. Our ratio of support troops to men in the combat arms has gone up every year, and I don't apologize for it a bit. Lots of things dictate it. Let me just give you a couple.

- We are living in a more affluent society and our soldiers demand a more affluent way of life. This costs support troops.
- We have much more sophisticated weapons. This means maintenance is more difficult and takes many more men. This means training takes more time and many more people. This means supplies and spares for these weapons requiring greater effort by more people.

"A fact of life is that in the Civil War for every man in combat we had .07 men supporting him. In Vietnam for every man in combat we had 3.5 men behind him . . . but I don't apoligize because I think there is a more important statistic that is too often overlooked—killed in action.'

"In the Civil War for every 1,000 men in combat, 43 were killed in action. In Vietnam for every 1,000 men in combat, three were killed in action. Therefore, I accept and support our increased support-to-combat ratio concept—as long as we are saving lives and getting the job done."

Secretary Froehlke then turned to research and development again with respect to "excess gadgetry . . . gold plating. I think the best explanation of gold plating is that well-meaning, highly motivated individuals want to make sure that our soldiers have the best possible weapons.

"As a result, as the weapon systems are developed, absolutely every technological improvement is put into the systems. We do come out with a wonderful weapon system. And I can cite you our Main Battle Tank . . . a wonderful weapon *but it cost too much money.*

"The attack helicopter, the Cheyenne, could fall in that category. No one questions the fact that it is a wonderful weapon, *but it costs too much money.* It is in the cost area where the scientists, working with the user, have a real difficult problem because techno-

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$250 Award Technical Papers

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involves three steps; the aqueous acetolysis of either hexamine or formaldehyde and ammonia to DAPT (1,5-diacetyl-3,7-endomethylene-1,3,5,7-tetrazacyclooctane); the acetylation of DAPT to TAT (1,3,5,7-tetraacetyl-1,3,5,7-tetrazacyclooctane); and the nitrolysis of TAT to HMX. The laboratory studies indicates that the yields of HMX via the process are at least equivalent to those of the existing process. In addition, the acetic anhydride consumption per pound of hexamine is substantially lower than the anhydride requirement in the present process. Lower costs and new options are among the advantages that could result from the discoveries, and these may have significant consequences for the Army's manufacturing responsibilities and the availability of the most powerful explosive for a wider range of munitions.

It has also been observed that TAT exists in three polymorphic forms. This finding represents the second case of polymorphism in the 8-membered tetrazacyclooctane ring system. HMX is the only other known compound with the tetrazacyclooctane skeleton that exists in distinct polymorphs.

Certificate of Achievement Technical Papers

TITLE: The Automated Dithionite Test for the Detection of Hemoglobin S in Military Personnel. A technic Evolved from Molecular Concepts

AUTHORS: CAMP, CONTE and NALBANDIAN
US Army Medical Research Laboratory

ABSTRACT: This automated diagnostic technic for the detection of hemoglobin S, the automated dithionite test, is derived from deductive and analytical considerations of highly sophisticated, precisely detailed molecular information on hemoglobin S as developed by basic science workers in the fields of physical chemistry, protein chemistry, x-ray crystallography, and biochemistry. These theoretically derived principles which have proven valid by extensive field testing are a measure of the rich fund of information on hemoglobin S available at the molecular level. Over 35,000 specimens from civilian and military populations have been screened for hemoglobin S. The automated dithionite test, mechanized and objective, is capable of precessing 120 specimens per hour, with a unit reagent cost of $0.02 and gives every indication that it is by far the most accurate and efficient technic for the detection of hemoglobin S in large human populations. The automation of this screening test eliminates the expense and vagaries of previous methods. For the first time statistical data can be collected from diverse sources and a means made available for the compilation of national statistics on morbidity and mortality for this disease.

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TITLE: The Effect of Folate on Abnormal Carbohydrate Metabolism

AUTHORS: GREENE, HERMAN, STIFEL, HERMAN and LUFKIN
US Army Medical Research and Nutrition Laboratory

ABSTRACT: Pharmacologic doses of folic acid increase the activities of human jejunal glycolytic and one gluconeogenic enzymes. Two enzymes which cause genetic deficiency diseases are known to increase in the jejunum with folate therapy. Hereditary fructose intolerance is due to hepatic fructose-1-phosphate aldolase deficiency. Fructose-1, 6-diphosphatase deficiency causes a hypoglycemic syndrome. The effect of folate on human liver enzymes has not been studied but since rate intestine and liver enzymes change concomitantly with folate therapy, it was postulated that human hepatic glycolytic enzymes also increased after folate administration. One patient with fructose-1-phosphate aldolase deficiency and two patients with fructose-1,6-diphosphatase deficiency showed clinical and biochemical improvement after folate therapy. These results suggest that non-substrate agents acting as potent inducers can be used to treat certain enzyme deficiencies.

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Certificate of Achievement Technical Papers

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Ethanol decreased hexokinase, fructose-1-phosphate and fructose-1,6-diphosphate aldolases and fructose-1,6-phosphatase activities. Ethanal increased pyruvate kinase activity. These decreases were overcome by oral folate (15 mg). The effects of folate and ethanol were seen not only with an isocaloric diet of constant composition but also with a regular diet selected from a hospital cafeteria. Investigation of the effect of ethanol on hepatic as well as jejunal enzymes may well give us answers to some of the heretofore puzzling aspects of disease associated with the chronic use of alcohol. The finding that folic acid inhibits the action of ethanol on glycolytic enzymes may also provide a more rational therapeutic approach to some of the ethanol-associated diseases.

TITLE: Human Engineering Laboratory Battalion Artillery Tests (HELBAT)
AUTHOR: HORLEY
Aberdeen Proving Ground

ABSTRACT: The Human Engineering Laboratory is conducting a series of field experiments superimposed onto Operational Readiness Tests which Army artillery units must undergo each year. These Human Engineering Laboratory Battalion Artillery Tests (HELBAT) have established procedures for battalion-scale testing, identified error sources within the artillery battalion, reduced error at the major source - the forward observer - and evaluated the artillery's capability to engage moving targets by indirect fire. The HELBAT tests have also contributed directly to the Operational Readiness Tests by adding objective performance data to the subjective evaluation of umpires and thus helping to identify weaknesses in battalion training and performance.

TITLE: Anisotropic Dose and its Applications in Directional Radiation Sensing
AUTHORS: KRONENBERG, LUX, RAMM, NILSON, PFEFFER and BERKOWITZ
Fort Monmouth

ABSTRACT: An unexpected effect was found during research on nuclear radiation effects on materials. A layer of material embedded in a medium of different atomic number was observed to markedly influence the dose deposited in its vicinity when the medium was irradiated with X-rays or gamma rays. This influence proved tangible even when the perturbing layer was very thin. The mechanism responsible for altering the local dose was investigated experimentally, and the magnitude and directionality of the anomalous dose were measured in various situations.
It was found that the anomalous dose is approximately proportions to the cosine of the angle between the normal to the plane of the perturbing layer and the gamma rays' direction of travel. This anisotropy was exploited to measure the directional distribution of gamma rays without the use of any collimation or "thick" (strongly absorbing) detectors. We constructed a lightweight (<3 lbs), hand-held directional radiation survey meter capable of scanning a nuclear radiation environment in much the same manner as a photographic exposure meter surveys the visible light distribution.

It is recommended that this phenomenon also be considered both when designing and testing electronic devices which must be hardened against nuclear radiation, and also in radiation dosimetry.

TITLE: The Effects of Vibration on Vision as Applied to Military Vehicles
AUTHOR: LEE
US Army Tank-Automotive Command

ABSTRACT: With the advent of high performance vehicles and stabilized weapons, there has been an additional emphasis on the performance of complex tasks in vibration environments by the crew members. This

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Froehlke Discusses Impact Of Summit Conference, Budget, MVA, R&D Problems

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logical improvement is not always operationally sound or economically sellable.

"We have to get into the area of trade-offs, priorities and relative costs. This is where we must have real communication between the scientist and the user, whereby we make sure that a weapon system has every gadget—if you will let me use that word—that is absolutely necessary, but not those gadgets that are not absolutely necessary.

"I, frankly, am in no position to draw the line, but the scientist and the user cannot use that excuse. They must draw that line—and the line cannot be drawn at no technical improvement, and it cannot be drawn at any and all technical improvements. Somewhere in between the line must be drawn, and if we don't draw it Congress will and Congress is.

"I'm bothered by the time it takes from the moment a user in the field says 'It would be nice if . . .' to the time he gets his if. Right now, I don't know what the time is, but we are talking about six to ten years.

"I can sit down with anybody who will give me the time, as I have with certain Congressmen, and explain rationally why it is in the best interest of this government to take six to ten years. But the answer I get back from the Congress is: You are taking too much time because (1) we have inflation and delay costs money; (2) you are taking too much time and the public doesn't understand it; the army is losing the confidence of the public; and (3) what about the readiness of the Army—what is happening in that six to ten year period? When you need that weapon, you are still developing it.

"We must get these weapon systems out facter. Bill Gribble (LTG Gribble, Chief of Army R&D) has been working very hard with our Installations and Logistics people, along with Bob Johnson (Assistant Secretary of the Army, R&D). I think we have a new order—a manifesto—coming out that is going to help us, but we need the cooperation of the scientific community."

Secretary Froehlke then discussed prospects for the Modern Volunteer Army, and the effects of the Vietnam war on the Army's public image. He conceded that the image had been hurt, saying "I get very discouraged by those who come to me as though they had made a profound discovery, saying 'You know, Vietnam hurt the Army.' Of course Vietnam hurt the Army.

"Regardless, the record of the Army in Vietnam is a record of success. It was not a military decision to go into Vietnam. It was a decision properly of our civilian political leaders. As a matter of fact, most of the ground rules for the fighting in Vietnam were ground rules set by the civilian political leadership.

"The Army was given the order: Stop the aggression; train the Vietnamese to take over, and then leave. The aggression was essentially stopped, the Vietnamese were trained to take over, and we are well on the way to getting out. The Army record in Vietnam is one of success. We don't have to apologize to anyone.

"The Army of the 70s is going to be a Volunteer Army. Achievement is going to be close. I certainly cannot guarantee it, but I think we are going to have a Volunteer Army, and I think so for four reasons:

- It is going to be a more professional Army based on the programs that are in progress.
- We are paying money in the Army today that is comparable to what can be earned in the civilian community—not higher, not lower, but in the ball park.
- We are offering the young man who is inclined to the military a way of life which he can accept.
- Most important of all, I think the Army is on the way back in the esteem of our fellow citizens.

"I believe that until we come back even further we cannot be confident of a Volunteer Army. Nevertheless, I see good trend lines and I believe that, with those four factors, we will have a Volunteer Army."

Secretary Froehlke closed his address with a strong expression of pride in his responsibilities and the mission of the Army, which he described as "Ready, willing and capable of waging war" under leadership "working, hoping, and praying for peace.

"And I believe that any historian, any commentator on the modern scene, must agree that one of the best things this world has going for peace is an Army of the United States of America that is ready, willing and capable of waging war, hoping, working, and praying for peace."

ABMDA Slates Oct. 25-26 Symposium To Report Findings of UpSTAGE Program

The U.S. Army Advanced Ballistic Missile Defense Agency (ABMDA) will sponsor a symposium Oct. 25-26 in the Institute of Defense Analysis auditorium, Arlington, Va. (400 Army-Navy Drive) to report on findings of its recently completed UpSTAGE Program.

This extensive program is reported to have significantly extended the state-of-the-art in ballistic missile defense interceptor technology in the areas of flight mechanics, propulsion, structures, guidance and control. The primary flight test objective was to determine the feasibility of engaging "severe" ballistic missile targets by boosting and maneuvering at several hundredths of G's acceleration and at few tens of milliseconds interceptor response times in closed-loop guided flights.

Additional information regarding the symposium may be obtained by contacting MAJ Albert F. Gleim of ABMDA, Area Code 202, OXford 44162.

MG Sammet Reviews Weapons During Visit to USASASA

Deputy Chief of Research and Development MG George Sammet Jr. recently visited the U.S. Army Small Arms Systems Agency (USASASA), Aberdeen (Md.) Proving Ground.

COL Raymond F. Isenson, USASASA commander briefed General Sammet on the agency's mission, small arms requirements documentation and current exploratory and advanced developments. Status reports were given on the future rifle, squad automatic weapon and the supplemental weapons subsystem for the infantry combat vehicle.

Discussed also were the aluminum-cased and lightweight ammunition program, improved sighting and aiming systems, and personal defense weapon systems studies.

Certificate of Achievement Technical Papers

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paper approaches the problem by quantifying the effects of vibration on vision.

The paper presents a unique method of measuring amplitude and phase of eye motion during whole-body vibration. Gain phase plots are generated and transfer functions are developed for both the head/input and eye/head ratios. The eye/head ratio is separated into vertical and angular motion of the eyes, and a transfer function is developed that relates the angular eye motion to the head motion. Both the head/input and angular transfer functions contain time delays.

The transfer functions are verified in both the frequency and time domains. Graphs are presented that show the correlation between the calculted and measured data. Subjects are required to perform a visual task that utilizes the vertical and angular transfer function. They are subjected to random vibration and the outcome of this test is given in tabular form.

The correlation of reading errors with eye motion is shown in graphical form.

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TITLE: Stress Singularities Associated with a Crack Inclined to a Bimaterial Interface
AUTHORS: PU, SCANLON and HUSSAIN
Waterviiet Arsenal

ABSTRACT: In this paper we have investigated the nature of stress singularities associated with a crack inclined to a bimaterial interface, under general loading conditions. The stress singularities were obtained from the eigenvalues of a characteristic equation. Careful study of these results indicated a paradox. We could find no angle of inclination of the crack tip to the interface for which the singularity had the same order as that of a crack tip lying in either of the individual materials.

The problem was then reformulated incorporating boundary layer effects via couple stress theory. The most dramatic result found was that there are only two possible angles of inclination of a crack to the interface for which the singular stress field of a crack in a homogeneous material could be preserved.

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TITLE: Electronic Processes in Explosives Initiation
AUTHORS: FAIR, DOWNS, FORSYTH, BLAIS and GORA
Picatinny Arsenal

ABSTRACT: Pseudostable materials undergo decomposition into a more stable form by rapid self-sustaining decomposition, deflagration or detonation. The materials are pseudostable because the initiation of the reaction requires that some activation energy be supplied by an external stimulus. Traditionally the stimuli have been considered to be either thermal or mechanical in origin, and little consideration has been given to the role of electronic processes in initiation. This work describes the determination of the electronic energy level structure in explosives using low temperature optical absorption techniques and the determination of electronic transport properties by photoconductivity measurements. Madelung potentials were theoretically determined and indicate the nature of the bonding within the crystal lattice. The possibility of the non-thermal, photo-electronic initiation effect was first predicted by our theoretical studies. These studies have focussed on the relationship between the chemical pseudostability of explosives and their electronic structure, and have suggested novel mechanisms for initiation of primary and secondary explosives, propellants and pyrotechnics. Specifically, photo-electronic initiation has been observed in lead and thallous azide. The effect has been characterized and interpreted in terms of the optical and electronic transport measurements on these materials.

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TITLE: Studies in Personnel Detection Radar
AUTHORS: ROBERTS, ANTONY and PEPERONE
Harry Diamond Laboratories

ABSTRACT: Detection of personnel obscured by foliage using radar techniques has been demonstrated, but its further development has been hampered by a lack of basic data and a theory of operation. Using recently collected backscatter time-series data, this paper evaluates by computer simulation the target detection capability of several signal processing techniques for a prescribed low false-alarm rate. The effect of various prewhitening filters on performance of a unique processor that adapts to clutter conditions in each range cell under observation is examined. The combined prewhitening filter and adaptive processor is found to provide the best target detection capability. A theory for predicting performance is proposed for the first time and is found to be consistent with the computer evaluation.

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TITLE: Growth of Large Single Crystals of Al_2O_3 by the Gradient Furnace Technique for Transparent Armor Applications
AUTHORS: VIECHNICKI and SCHMID
Army Materials and Mechanics Research Center

ABSTRACT: Transparent armor materials for aircraft application must be optically clear, lightweight, and capable of defeating fragments and projectiles. Single crystal Al_2O_3 has these properties, but before the initiation of this in-house Army Materials and Mechanics Research Center program, no process existed for the economical and reproducible fabrication of large plates of single crystal Al_2O_3 suitable for use in transparent armor systems. This paper will describe the evolution of the gradient furnace technique from initial research efforts with laboratory-sized specimens through to scale-up efforts which have reproducibly fabricated 4.5 Kg ingots. The sapphire has been well characterized using optical and X-ray techniques. These studies, as well as studies of the mechanical and ballistic properties of the sapphire, will be discussed. Finally, the cutting and finishing of these large ingots and the production of a 40 cm x 34 cm experimental transparent armor windshield will be reported.

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TITLE: A Ballistic Research Laboratories Lightweight Army Concept
AUTHORS: MERENDINO, REGAN
Aberdeen Proving Ground

ABSTRACT: A new armor concept has been devised recently at the Ballistic Research Laboratories and is identified as the BRL Lightweight Armor. The concept is a result of a better understanding of penetration by shaped charge jets.

Jet-armor interactions are exploited to defeat shaped charge jets and kinetic energy projectiles at nominally 50 percent of the weight of conventional monolithic steel armor required for the same purpose. The jet-armor interactions are illustrated and explained, as well as demonstrated experimentally. The armor concept is described and its weight efficiency is demonstrated.

Army Science Conference Technical Papers

TITLE: A Thixotropic Fuel for Tactical Missiles
AUTHOR: ALLAN
Redstone Arsenal

ABSTRACT: A significant increase in either range or warhead weight can be obtained by substituting a metallized gelled fuel for the neat fuel in typical Army systems. This technology is applicable to future general support or division support missile sytems as well as certain smaller systems. The formulation for MICOM GEL, and Army- developed fuel, was chosen on the basis of extensive laboratory tests, system

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RDT&E, Materiel Procurement Contracts Total $482.9 Million

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sile; General Motors Corp., $3,216,800 for transmissions for M578 and M109 combat vehicles; and

GTE, Sylvania, Inc., $2,970,626 and ITT Defense Communications, $2,970,626 for prototype automatic switches; Dynamics Corp. of America, $2,940,000 for low tower amplifiers for Satellite Communication Ground Terminal, associated data and spare parts; LTV Aerospace Co., $2,924,653 for engineering services for the Lance missile system; and

General Dynamics Corp., $2,861,360 for modification of the Redeye weapons eighth production buy; TRW, Inc., $2,727,955 for classified R&D; Philco Ford Corp., $2,712,500 for 1A modules for the Chaparral missile system; Philco Ford Corp., $2,691,262 for Chaparral missile system support; and

Stan Flowers, Inc., $2,512,873 for shipwright services; Radiation, Inc., $2,500,000 for classified electronics equipment; Texas Instruments, Inc., $2,467,874 for software development for the Terminal Support Program for the Army Ballistic Missile Defense Agency; AVCO Corp., $2,363,052 for M550 fuzes for M433 40mm cartridges; and

General Motors Corp., $2,335,000 for major component evaluation, test and development for new prototype tank system; Tracor, Inc., $2,299,475 for the Weapon Engagement Scoring System; Bendix Corp., $2,165,830 for TALOS guided missiles; and

Maxson Electronics Corp., $2,094,500 for fuzes for the Pershing missile; Honeywell, Inc., $2,041,520 for grenade fuzes; Chrysler Corp., $2,028,126 for improvement on the M60A1 tank; Norris Industries, Inc., $2,024,794 for M54 rocket motors; Etowan Mfg. Co., $2,023,680 for delay arming assemblies; LTV Aerospace Corp., $2,018,177 for equipment for the Lance missile system; and

Pioneer Recovery Systems, Inc., $1,957,289 for canopy and cargo parachutes; Radiation, Inc., $1,951,000 for modules, encoders and code plugs; Action Mfg. Co., $1,947,402 for rocket fuzes; Raytheon Co., $1,939,608 for test equipment for the Hawk missile system; Chrysler Corp., $1,925,000 for a new tank system; Pacific Car and Foundry Co., $1,899,312 for services in support of M107/M110 and M578 tracked vehicles; and

Computer Sciences Corp., $1,890,001 for scientific effort; Textron, Inc., $1,856,267 for helicopter maintenance; General Motors Corp., $1,811,736 for Army Tank Task Force support and prototype tank system studies; Philco Ford Corp., $1,770,128 for development of the XM140E5 weapon; and

AVCO Corp., $1,707,086 for case assemblies for Lance Missiles; Marathon LeTourneau, Inc., $1,700,000 for M17A3 bomb parts; Colt Industries Operating Corp., $1,690,119 for M16A1 rifles; Western Electric Co., $1,663,334 for work on the Safeguard ABM system; A. M. General Corp., $1,653,652 and $1,620,378 for M809 5-ton trucks; and

AVCO Corp., $1,630,720 for booster adapters; Athey Products Corp., $1,577,106 for forklift trucks; Raytheon Co., $1,564,000 for M905 fuzes for 750-pound bombs; General

Motors Corp., $1,500,000 for diesel and turbine applications to new prototype tank system; AVCO Corp., $1,500,000 for development of the AGT1500 turbine engine; and

Amron Orlando Corp., $1,490,720 for M551, MPTS point detonating fuzes; Northrop Corp., $1,447,650 for 2.75-inch rocket warheads; Litton Systems, Inc., $1,441,905 for AN/TSQ-73 prototypes; United Aircraft Corp., $1,435,300 for a ballistic- and crash-resistant fuel system; Hughes Aircraft Co., $1,423,000 for lightweight laser designator models; and

Western Electric Co., $1,409,720 for the Safeguard ABM perimeter acquisition radar; Sperry Rand Corp., $1,408,702 and Hughes Aircraft Co., $1,408,701 for artillery locating radar; U.S. Small Business Administration, $1,404,480 for aerial delivery cargo bags; Bulova Watch Co., $1,403,125 for engineering efforts and production of M567 fuzes; and

Olin Corp., $1,394,455 for M73 35mm subcaliber practice rockets; Hoffman Electronics Corp., $1,387,728 for nozzles and fin assemblies; Melpar Division, E-Systems, Inc., $1,373,614 for Lance missile system fuzes; Teledyne Continental Motors, $1,337,701 for engineering services for the LDT-465-1C and LD/LVS-465 multifuel engines; and

AVCO Corp., $1,337,000 for modification of aircraft engines; Ellinor Corp., $1,330,138 for expanded dissipating energy pads; RCA Corp., $1,330,125 for image intensifier assemblies; AVCO Corp., $1,286,200 for a design model of a missile detection system; Chamberlain Mfg. Corp., $1,282,210 for high-explosive, antitank tracer projectiles; and

Boeing Co., $1,275,894 for publications in support of the CH47 aircraft series; Textron, Inc., $1,208,665 for modification kits for UH-1 aircraft; General Motors Corp., $1,207,231 for diesel engines for M578 vehicles; Boeing Co., $1,200,044 for engineering for helicopter rotor blades; Burtek, Inc., $1,195,766 for the Hawk missile system; and

Bendix Corp., $1,193,675 for remanufacturing of ST120 Pershing platforms; W. A. Apple Mfg., Inc., $1,183,605 for cargo bags; M. Stienthal and Co., Inc., $1,171,682 for cargo parachutes; Western Electric Co., $1,117,932 for repair parts for the Safeguard ABM system; Bendix Corp., $1,113,218 for Pershing missile test stands refurbishment; and

Motorola Corp., $1,112,234 for position sets for the Long Range Positioning Determining System; Babcock Electronics Corp., $1,088,722 for Lance missile system fuzes; Chamberlain Mfg. Corp., $1,086,105 for projectiles; Teledyne Electronics, $1,083,000 for transponder test sets and radar test sets; and

Falcon Research and Development Co., $1,068,046 for R&D pertaining to vulnerability of materiel targets; ICI America, Inc., $1,033,459 for operation and maintenance of a TNT production facility; Union Carbide Corp., $1,032,578 for radio set batteries; Massachusetts Institute of Technology, $1,030,000 for basic and applied research of general physics, plasma dynamics and communication sciences and engineering; and

The University of Illinois, $1,020,000 for basic and applied research in modern electronic sciences; and Varo Electron Devices, Inc., $1,003,688 for image intensifier assemblies.

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analysis, and previous research. Available tactical flight-weight hardware, with minimum redesign, was used to successfully demonstrate its performance potential. The research indicates that a typical neat liquid propulsion system can be adapted to a gelled propellant and that the large increase in range or warhead weight realizable by this conversion makes further development desirable.

TITLE: Fast Neutron Radiography
AUTHORS: ANTAL and BECKER
Army Materials and Mechanics Research Center

ABSTRACT: There has been a revival of interest in neutron radiography due in part to the need for inspection of components fabricated from new structural materials such as composites and polymers, and the characterization of these materials in the course of their development. Neutron radiography normally employs neutrons of thermal energies (less than 0.1 eV) which are produced by moderating the fast (high energy) neutrons emitted by nuclear reactions in sources. Fast neutron radiography, employing neutrons directly from the sources (MeV energies) is possible with a new imaging process described in this paper. The fast neutron image is formed in a permanent manner in the surface of a film of plastic by etching microscopic pits at sites sensitized by protons created in an adjacent converter film upon which the neutrons have impinged. The etched image can be viewed with the unaided eye and printed photographically. The imaging system is inexpensive, is totally insensitive to gamma rays from californium-252 neutron sources, and permits high resolution fast neutron radiographs to be produced with a minimum amount of accessory equipment. Fast neutron radiograph with this imaging system and a californium-252 isotopic neutron source would appear to have application to the general field of radiography in addition to the special materials inspection problems for which it was originally sought.

TITLE: Advanced High Energy Missile Control Systems
AUTHOR: ATHA
Advanced Ballistic Missile Defense Agency

ABSTRACT: Work is currently underway on several advanced missile control systems to meet the stringent control requirements of advanced ABM interceptor missiles. These requirements include response time, force level, system weight as well as the ability to function in severe environments of acceleration, nuclear blast, and high aerodynamic heating rates. A class of control concepts which utilize the interaction of an injected fluid with the airstream surrounding the missile to achieve control forces offers much promise to meet these requirements.

This paper describes three of these advanced control concepts: (a) external burning -- in which a liquid pyrophoric fuel mixes with the air and burns producing a region of high pressure, (b) jet interaction -- in which a gaseous jet separates the boundary layer producing a high pressure region; and (c) reactive jet interaction -- in which a fuel rich gaseous jet separates the boundary layer and mixes with the air and burns thereby producing high pressure region by combining both of the previous concepts.

Analytical methods are described for predicting the surface pressure distributions, both upstream and downstream, of the injector using both circular and slot nozzles for jet interaction controls. Semi-empirical methods are described for predicting surface pressure distributions for both surface and finlet injectors for external burning controls. Experimental data for pressure distribution and heat transfer are discussed.

TITLE: Spectral Deficits in Visual Acuity Due to Laser Irradiation
AUTHORS: ZWICK, BEDELL and BLOOM
Frankford Arsenal

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Army Science Conference Technical Papers

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ABSTRACT: The increased employment of laser rangefinders and illuminators has caused much concern over the visual effects due to tactical use of these systems. In this study, the possible effects on photopic visual function following foveal laser irradiation were evaluated in trained animal subjects (Rhesus monkeys). Preliminary results of this experiment indicate that foveal laser injury can cause severe deficits in the spectral acuity and the photopic spectral sensitivity of irradiated animal subjects.

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TITLE: Acid-base Change in Heat Exhaustion During Basic Training
AUTHORS: BOYD and BELLER
US Army Research Institute of Environmental Medicine

ABSTRACT: Hyperventilation has been described as a normal physiologic response to heat stress. In order to evaluate the possible role of this hyperventilation response in the pathogenesis of heat exhaustion, all heat casualties evacuated to the Fort Polk, LA heat ward during a 2 week period were studied. There were 17 patients with heat exhaustion and one with heat stroke in whom detailed clinical data, and arterial and venous blood samples were obtained immediately upon admission. Of the 17 patients with heat exhaustion, 11 presented initially with syncope, 16 had severe muscle cramps, 9 had frank tetany, and all were hyperventilating (mean respiratory rate: 26/min) on entry. The mean admission rectal temperature in the group was 100.4 ± 0.25 °F. Mean arterial pH and pCO_2 values were 7.62 ± 0.03 and 23.5 ± 2 mm Hg, while the mean arterial lactate and pyruvate concentrations were in the normal range, indicating the presence of a marked primary respiratory alkalosis in this group. The mean serum sodium, potassium, chloride, magnesium and creatinine concentrations were normal in the heat exhaustion patients. Only 2 patients appeared to be severely dehydrated as reflected by clinical signs, hypernatremia and azotemia. Recovery was rapid and complete in all patients within a few hours. Volume depletion is considered an important etiologic factor in the heat-exhaustion syndrome, but this study suggests that many of the clinical manifestations of heat exhaustion may be the result of an exaggerated hyperventilatory response to heat stress which is associated with a marked respiratory alkalosis.

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TITLE: Improved Sound Ranging Location of Enemy Artillery
AUTHORS: SWINGLE, CRENSHAW and BELLUCCI
Hq Army Materiel Command

ABSTRACT: A major improvement in sound ranging computational techniques has been developed and demonstrated. Target location data produced by the USRAN3 technique are degraded much less by errors in input data, including meteorological correction data, than are those of the field method.

When tested on a set of 1863 target locations, it yielded 43% more fixes with errors less than 45 meters. The overall probable error of target location was reduced from 117 meters to 96 meters.

The new method is readily adaptable to either manual or computer solution of the sound ranging problem and can be implemented by personnel having the skills normally available in GR-8 operations.

With no new materiel development or procurement costs, this new technique for making better use of available equipment is expected to make possible direct savings of approximately 30% in munitions expended in attacking enemy firing units detected by the already fielded GR-8 system. This is estimated to average about $4600 per counterbattery attack. Of greater significance in a conflict with a technologically sophisticated enemy would be the reduction in the number of times that friendly artillery units firing counterbattery missions would expose themselves to enemy counterbattery location and attack.

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9 Army Civilians Selected To Attend Service Colleges

Nine Department of the Army civilian employes have been selected to attend senior service colleges in the 1972-73 academic year.

These schools are intended primarily for training senior military officers, but each year a small number of civilians are accepted as students. Selection is considered an outstanding honor, sought after by both military and civilian personnel. The selectees are:

National War College—Mrs. Angeliki D. Cutchis, chief of the Combat Systems Division, Office of the Chief of Staff for Force Development, Washington, D.C., and Walter W. Hollis, scientific adviser to the CG, Combat Developments Experimentation Command, Fort Ord, Calif.

Army War College—Dr. Charles N. Davidson, scientific adviser, U.S. Army Combat Developments Command Nuclear Agency, Fort Bliss, Tex.

Industrial College of the Armed Forces—Ralph G. Kabureck, chief of the Industrial Support Branch, Office of the Deputy Chief of Staff for Logistics, Washington, D.C.; Dr. Donald E. Westcott, chief of the Plant Products Division, Food Laboratory, U.S. Army Natick (Mass.) Laboratories; William A. Bayse, technical director, Office of the Deputy Chief of staff for Logistics Data Processing Center, Washington, D.C.; James A. Kennedy, Office of the Assistant Director of Army Budget, Comptroller of the Army, Washington, D.C.; Reuben D. Cook, chief of the Research and Technology Division, Directorate of Advanced Systems, U.S. Army Topographic Command, Washington, D.C.

Armed Forces Staff College—Bennie L. Robbins, technical chief, Plans and Technical Branch, U.S. Army Strategy and Tactics Analysis Group, Bethesda, Md.

Army Secretary Initiates Awards To Spur Materiel Acquisition Effort

Initiation of the Secretary of the Army's "Award for Outstanding Achievement in Materiel Acquisition" has been announced to stimulate competitive effort in a high-priority program.

A silver medallion and a miniaturized version in the form of a lapel pin will be awarded to individuals or teams, military or civilian, who contribute outstandingly for at least 12 months to the timely, efficient, and economical acquisition of quality supplies and services.

Ten winners will be announced annually in December, except that 1971 and 1972 winners will be named in the near future.

Considerations will include the complexity of the problem involved, degree of initiative and originality displayed in solving it; the relative significance of the accomplishment in light of the mission of the activity; the possibility of direct application or adoption of the contribution by other activities; and the degree of improvement in program management.

Subordinate commanders will submit nominations through channels to the Deputy Chief of Staff for Personnel, Attn: Executive Secretary, Army Incentive Awards Board, Department of the Army, Washington, D.C., 20310.

Career Programs . . .

Nominees for BG Rank Include 5 R&D Colonels

Five of the 62 colonels President Nixon approved recently for promotion to brigadier general rank are members of the highly selective Army Research and Development Career Officer Program. COL Jerry B. Lauer, a non-member choice, is presently assigned to the Office of the Chief of R&D.

R&D Career Officer Program selectees are COLs Joseph E. Fix III, John G. Jones, William J. Kennedy, Donald R. Keith and Charles F. Means.

COL FIX is commander of Detachment 1, Joint Task Force 728, Defense Special Projects Group, Washington, D.C., with duty station in Germany. He was assigned as staff officer in the Combat Arms Branch, Combat Materiel Division, OCRD (1965-66) before serving nearly two years as executive secretary of the Army Scientific Advisory Panel.

Other key assignments have included: CO, 1st Brigade, 4th Infantry Division, in Vietnam; deputy assistant chief of staff, G-1, Headquarters, U.S. Army Vietnam; and chief, Operations Division, Defense Special Projects Group, Washington, D.C.

COL Joseph E. Fix III

Graduated from the University of Omaha with a BGE degree in general education, he has an MS degree in international affairs from George Washington University.

COL Fix holds the Silver Star with Oak Leaf Cluster, Legion of Merit with OLC, Bronze Star Medal, Air Medal (7 awards), Army Commendation Medal with two OLC, Purple Heart, Combat Infantryman Badge (2d award), and the Master Parachutist Badge.

COL JONES is assigned as military assistant, Office of the Deputy Secretary of Defense, Washington, D.C. His R&D assignments have included: mechanical engineer, Mobilization Branch, Directorate of Research and Development, and (later) chief, Programs Management Division, Army Materiel Command; chief, Programs Management Division and (later) chief, Programs, Plans and Opera-

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Army Science Conference Technical Papers

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TITLE: Measures and Countermeasures for Predetonation of Buried Pressure Electric Mines
AUTHORS: STIBER, HABER, CURRAN and BERGER
Fort Monmouth

ABSTRACT: This paper describes the results of an engineering investigation conducted by the US Army Electronic Warfare Laboratory (ECOM) to determine the technical and operational feasibility of a technique to prematurely detonate pressure electric mines buried under road surfaces in areas such as Southeast Asia. In addition, studies and field investigations were conducted to determine the most effective means an enemy might employ as countermeasures against such a technique.

The daily personnel casualties and continued vehicle losses attributed to mines buried in roads indicated a need for a swift solution which would reduce losses.

This paper describes the results of laboratory investigations leading to an effective solution and a description of field tests of the techniques imployed in a test vehicle. In addition, it describes techniques an enemy might employ to defeat the system and field tests of these countermeasure techniques. Recommendations for future programs for improved systems are suggested.

◆

TITLE: Increased Density for Military Foods
AUTHORS: RAHMAN, HENNING, BISHOV and WESTCOTT
Natick Laboratories

ABSTRACT: Reducing the volume of foods saves military cargo and storage space, lessens the requirement for packaging materials, and hence decreases waste. Recently a new approach to this problem of reducing volume was undertaken; namely, examining the possibility of developing techniques for compressing certain foods (in our case, freeze-dried fruits and vegetables) and subsequently restoring them to their original state by rehydration. Many variables were studied--blanching, cooking, freezing, freeze-drying-- with special attention given to effects on cell structure and physical characteristics of reversibly compressed vegetables. Histological studies on peas showed that compression forces as high as 2000psi result in only a slight breakdown in cell walls. It was learned that rate of freezing is the single most important factor affecting the cell structure of carrots. Results of these experiments indicate that compressed foods capable of being restored to their original state are possible. Reduction in volume ranging from 4 to 16-fold were achieved, or, stated more graphically one truckload of compressed green beans contains as much food as 16 truckloads of the noncompressed.

◆

TITLE: Dynamic Response of Reinforced Openings in Rock
AUTHOR: BLAKEY
US Army Engineer Division

ABSTRACT: The objective of this research was to develop a solution, using numerical methods, to the problem of time-varying response of reinforced circular openings in rock subjected to dynamic disturbances of the underground environment. To meet this objective, timewise variations in the amplitude of displacement, velocity and acceleration associated with every point of the rock-structure system are needed, together with stress-strain values for detailed design. Steps in the research included literature search; examination of analytical methods of solution; use of the finite element method to model the opening reinforcement, with consideration of bending stiffness, and to model the rock continuum, acting in two-dimensional plane strain; analytical and numerical investigation of the stability of the linear acceleration method of integration of the dynamic finite element equations of motion; construction of a digital computer program incorporating the previous analysis that would meet the previously stated objective; and behavioral studies of the finite element method as applied to dynamic analysis, including numerical solution to the opening problem with ver-

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ification by comparison with existing analytical solutions. The major contributions of the paper are the quantitative behavioral studies of the finite element method in dynamic analysis, the investigation of numerical method stability for multidegree systems and the resulting computer program for dynamic analysis.

TITLE: High-Temperature Polyamides from New Hexahydrobenzodipyrrole Monomers
AUTHORS: STAPLER and BORNSTEIN
Natick Laboratories

ABSTRACT: The Army has a high priority to provide protective clothing to air and tank crewmen who are subject to intense heat and flame as a result of accident or enemy action. Presently available clothing materials derived from synthetic polymeric fibers have been evaluated in laboratory tests and also on full scale mannequins. The uniformed mannequins were exposed to aviation-fuel fires simulating real situations. Results indicate that available materials are capable of only partially fulfilling the requirements established for such protective items in regard to time of exposure and thermal protection. Therefore, an intensive search for new and improved high temperature fiber-forming polymers for possible replacement of presently available materials was begun. This search has recently resulted in a new class of heterocyclic polyamides made possible by the synthesis and isolation of two new hexahydrobenzodipyrrole monomers, the realization of which has eluded the efforts of other researchers since 1947. These newly prepared monomers reacted readily with diacid chlorides to form polyamides. All polyamides prepared from the monomers for this study show good thermal stability as indicated by TGA. Initial properties of the bulk polymers compare favorably with those of Nomex. Variations of the preparation show promise of furnishing products with improved properties.

TITLE: Disposal of Cellulosic Waste Materials by Enzymatic Hydrolysis
AUTHORS: MANDELS, HONTZ, and BRANDT
US Army Natick Laboratories

ABSTRACT: Nearly total hydrolysis of cellulose by enzymes of the fungus Trichoderma viride has been demonstrated. Cultural conditions have been optimized for production of the enzyme in quantity, and mutant strains of the fungus with enhanced cellulase production have been produced by irradiating conidia of the wild strain with high energy electrons. Pretreatment of the cellulose substrate by ball milling has led to increased bulk density and increased reactivity. Adsorption of the cellulase on the cellulose particles has been used to immobilize the enzyme on columns or in stirred tank reactors. As the cellulose is digested the released enzyme is readsorbed on excess or newly added cellulose with retention of activity. Sugar syrups can be continually separated from the enzyme-cellulose complex by elution from the column, or by filtration. Model systems have been operated using waste paper as a substrate.

The development of these systems has a potential for alleviation of pollution problems due to waste cellulosic materials of military origin and will yield simple sugars as a valuable product that can be utilized directly as food or converted to fermentation products including single cell protein, chemicals, and fuels.

TITLE: New Class of Materials for High Energy Storage Applications from Crystallization of Inorganic Dielectric Glasses under Pressure
AUTHORS: ZETO, HRYCKOWIAN and BOSCO
Fort Monmouth

ABSTRACT: The preparation of a niobate glass/ceramic by using low hydrostatic gas pressures to improve the dielectric properties was in-

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Nominees for BG Rank Include 5 R&D Colonels

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tions Division, Project Main Battle Tank; and assistant for Combat Materiel, Office of the Assistant Secretary of the Army (Research and Development).

His command assignments have included: CO of the 2d Battalion, 33d Armor, 3d Armored Division and CO, 8th Infantry Division, Support Command, both in Europe.

A 1950 graduate of the U.S. Military Academy, COL Jones holds two MS degrees—in mechanical engineering from the University of Southern California and in business administration from George Washington University.

His medals and awards include the Legion of Merit with two OLC, Bronze Star Medal, Joint Service Commendation Medal, Army Commendation Medal, and the Parachutist Badge.

COL KENNEDY is commanding the 7th Signal Brigade, United States Army, Europe. Graduated from the U.S. Military Academy in 1949, he earned an MS degree in electrical engineering from the University of Illinois.

COL John G. Jones

In R&D assignments, he has served as a staff officer in the Office of the Assistant Director (Command and Control), Office of the Director of Defense Research and Engineering (ODDR&E), OSD; and military assistant, Office of the Assistant Director (Information and Communications), ODDR&E.

COL Kennedy commanded the 52d Signal Battalion in Vietnam (1966-67) before being named chief of the Defense Systems Support Office, Office of the Assistant Chief of Staff for Communications-Electronics.

He holds the Legion of Merit, Air Medal, Army Commendation Medal with two OLC, and the Army Aviator Badge.

COL KEITH heads the Research and Analysis Directorate, Civil Operations and Revolutionary Development Support, U.S. Military Assistance Command, Vietnam.

career programs

A 1949 graduate of the U.S. Military Academy, he later earned an MA degree in science teaching from Columbia University. He has graduated from the Command and General Staff College, Armed Forces Staff College, and the Industrial College of the Armed Forces.

COL Keith was a staff officer with the Combat Arms Branch, Combat Materiel Division, OCRD (1963–64) before being assigned as assistant secretary, General Staff, Staff Action Control Office, Office of the Chief of Staff. In another key assignment, he was special assistant to the Chief of Staff (Chief Comptroller, Exercise Golden Rod, later Management and Programs Study Group), V Corps, United States Army, Europe. In June 1971 he completed an assignment as executive officer, OCRD, after commanding the 36th Artillery Group in Europe.

COL Donald R. Keith

His awards include the Legion of Merit with OLC, Meritorious Service Medal, and Army Commendation Medal with OLC.

COL MEANS is one of the Army members of the Weapons Systems Evaluation Group, Office, Secretary of Defense.

Graduated from the U.S. Military Academy in 1950, he holds an MS degree in aeronautical engineering from the University of Michigan (1959). He is also a graduate of the Command and General Staff College and the Army War College.

COL Means was chief of the Development Coordination Section, Pershing Branch, SSM Division, R&D Directorate, U.S. Army Guided Missile Command for six months in 1962 until assigned to the Pershing Project Manager Office at Redstone Arsenal, Ala., as deputy chief, Systems Engineering Division.

In Vietnam (1969–70), he was chief of the Ground Combat Division, Army Concept Team.

He holds the Legion of Merit with two OLC and the Army Commendation Medal with OLC.

COL LAUER is chief, Air Mobility Division, OCRD. A 1949 graduate of the U.S. Military Academy, he earned an MS degree in electrical engineering from Georgia Institute of Technology in 1960.

He was chairman of the Department of Defense Air Munitions Requirements and Development Committee, OCRD, from May 1971 to March 1972.

In other key assignments, he has served as a staff officer with the Long Range Plans Branch, Plans Division of OCRD (1965–66),

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vestigated for the purpose of developing new high energy density capacitor materials for laser applications. The energy density obtained by using nitrogen gas pressures was double that obtained from conventional room pressure crystallization. Improved oxygen stoichiometry in the niobate crystal lattice was elucidated as the mechanism by which pressure effected higher energy density. On the basis of this mechanism, oxygen gas pressures were utilized and theoretical dielectric strength of 3000 volts/mil was attained. The energy density was three times greater than that obtained without the use of pressure. The magnitude of the energy density, 140 joules/pound at 1500 volts/mil, not only surpasses that of state-of-the-art organic capacitors but also satisfies current military requirements for laser applications. The oxygen gas pressure technique also yielded transparency in the polycrystalline ferroelectric material which now has the additional potential of electro-optic applications. The fundamental principles uncovered by this study are analogously applicable to other electronic ceramic oxides used for dielectric, electro-optic, magnetic, and microwave applications. Since improved properties of a wide variety of electronic materials may result, the present work represents a significant technological breakthrough from basic research.

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TITLE: On the Theory of Stopping of Fast Charged Particles
AUTHOR: BRYNJOLFSSON
Natick Laboratories

ABSTRACT: The current formulation of the theory on the stopping of fast charged particles in condensed matter is inadequate for calculations of the average excitation potentials. For all practical purposes, one must therefore rely on the experimentally determined values. The author has elaborated on the stopping theory by Bohr, Bethe, Block and Fermi and has derived new equations for condensed matter which agrees well with experiments and which permit theoretical determination of the apparent average ionization potentials. The use of the equations is illustrated in this paper by calculating the stopping power for aluminum, and excellent agreement is demonstrated with the experimentally determined values. The average ionization potential for 300 MeV protons at lower energies. The present improvements, which result in two new corrections Δ_3 and Δ_4, are obtained by treating more vigorously the effect of coupling between different oscillators. Δ_3' depends on the oscillator strengths and the energy levels in the atom as well as the di-electric shielding constants. The correction Δ_4 is related to the upper limit of the impact parameter and results in a substantial decrease in the apparent average excitation potential with increase in the incident particle's energy; this correction is a relativistic effect.

◆

TITLE: Experimental Verification of Theoretical Predictions of Self-Induced Beam Distortion for High Power Density Laser Beam
AUTHORS: RHODE and BUSER
Fort Monmouth

ABSTRACT: Experimental and theoretical results obtained during the Army's 71 and 72 in-house high power laser propagation program are presented and discussed. Novel Experimental Techniques and operational procedures lead to the following conclusions: Most reliable method for the determination of beam quality is beam translation or slewing; existing theoretical models translated into propagation engineering nomograms are well predicting the observed propagation effects.

◆

TITLE: Discharge of Helicopters by Electronically Controlled Emission of Charge Carrying Liquid Droplets
AUTHORS: BUSER, KAUNZINGER and INSLERMAN
Fort Monmouth

ABSTRACT: A new concept for an electronically controllable discharge of surface charges which may accumulate on helicopters and present a considerable hazard to personnel is explored. It uses mechanical

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transport of charges by liquid droplets. Theory of nozzle produced sprays operating in electric field gradients is developed and criteria for efficient charge transport are established. Experimental results for single nozzles and multiple nozzle clusters are presented, and the application of these results to the Army's ongoing Heavy Lift Helicopter design study given. Nozzle clusters with a current capacity of 100 μA have been tested.

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TITLE: Use of Magnetic Latitude Simulator and Data Processing in the Development of Sophisticated Land Mine Fuzes
AUTHOR: BUTLER
Harry Diamond Laboratories

ABSTRACT: The Harry Diamond Laboratories has measured accurately the performance of magnetic antitank mine fuzes through the use of a magnetic latitude simulator (large coil system), automated magnetic data acquisition system, and computer. These facilities were used to accumulate a magnetic signature data bank and to play mathematical models of fuze target response against these signatures. Agreement with field test data was within the precision of the field tests.

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TITLE: Rare-Earth Cobalt Permanent Magnet Materials for Electromechanical Energy Conversion Devices
AUTHORS: IAFRATE, ROSS, ROTHWARF and CAMPAGNOULO
Fort Monmouth

ABSTRACT: The recent development of the high coercivity, rare-earth alloys such as cobalt-samarium and cobalt-cerium represents a major advance in the field of applied magnetism. The unique properties of these materials promise to revolutionize the design of devices employing permanent magnets. These properties include an energy product $(B \cdot H)_{max}$ of 23 MGOe and an intrinsic coercivity, H_{ci}, as high as 28 kOe, which far exceed the $(B \cdot H)_{max}$ and H_{ci} of the best permanent magnet materials previously available. Such properties now permit new static and dynamic applications previously not possible. Tiny, powerful electromechanical energy conversion devices can now be developed. The design of a new moving coil energy converter employing Co_5Sm or Co_5Ce is discussed in detail. The device can be used to convert mechanical motion into electrical energy. Its application to improving the power output of a fluidic generator system used as a power source for artillery and rocket fuzing is discussed. Theoretical predictions are given. Applications of rare-earth magnets to electronically tuned microwave filters and power limiters are also presented.

+ Harry Diamond Laboratories, Washington, D.C.

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TITLE: The Pre-Clinical Detection of Chemical Mutagens and their Evaluation as Genetic Health Hazards
AUTHORS: CAPIZZI and PAPIRMEISTER
Edgewood Arsenal

ABSTRACT: The genetic health hazards posed by chemically induced mutations are of special interest to Edgewood Arsenal because of the need for evaluating chemical agents and drugs in male volunteers and concern for the safe disposal of old chemicals. Since available tests for mutagenicity have many limitations, we developed a host-mediated assay for the detection and evaluation of chemically-induced somatic cell mutations which closely aproximates clinical conditions in man. A murine lymphoblast which requires an exogenous source of the amino acid L-asparagine for growth, ($L5178Y/ASN^-$), is used to study reverse mutations to asparagine independence. Cells grow equally well in cell culture and when implanted in the peritoneal cavity of mice. In vivo exposure to the chemical automatically considers such important factors as host biotransformation, etc., whereas, this cannot easily be considered in in vitro tests. Lethal and mutagenic effects of sulfur

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Nominees for BG Rank Include 5 R&D Colonels

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as chief of the Analysis and Control Division, U.S. Army Airborne Electronics and Special Warfare Board, Fort Bragg, N.C., and CO, 3d Brigade, 7th Infantry Division in Korea (1969-70).

His awards include the Legion of Merit with OLC, Army Commendation Medal with OLC, Combat Infantryman Badge, Army Aviator Badge and Master Parachutist Badge.

Six others on the brigadier general promotion list, though not in the R&D Officer Career Program, are serving in or have held R&D assignments.

COL Kenneth E. Dohleman is deputy director of the Doctrine, Evaluation and Command Systems Directorate, Office, Assistant Chief of Staff for Force Development (ACSFOR), Washington, D.C.

COL Jerry B. Lauer

COL Dohleman in 1970-71 was chief, Doctrine, Test and Evaluation Division, Doctrine and Command Systems Directorate, ACSFOR. A graduate of the University of Omaha, he holds a BS degree in political science. His military schooling includes the Command and General Staff College, Armed Forces Staff College, and Army War College.

COL Lloyd J. Faul, project manager, Office of the Project Manager, 2.75-inch Rocket System, Dover, N.J., has a BS degree in military science from the University of Maryland and an MBA in industrial management from Babson Institute. His military schooling includes the Command and General Staff College, Armed Forces Staff College, and the Army War College.

COL John W. McEnery is commander of the 2d Brigade, 1st Cavalry Division, Fort Hood, Tex. From July 1963 to September 1965, he was a staff officer (Research and Development) in the Coordination Division, Office of the Director of Coordination and Analysis, Office, Chief of Staff, Washington, D.C.

career programs

COL McEnery graduated from the U.S. Military Academy and has attended the Command and General Staff College, Spanish Staff College, and the Air War College.

COL Paul T. Smith, deputy commander for Tactical Systems, U.S. Army Computer Systems Command, Fort Belvoir, Va., served as management analyst and was later task leader in the Adjutant General Research and Development Command, Washington, D.C. (1959-62).

COL Smith holds a BS degree in military science and an MBA in business administration from the University of Maryland. He has attended the Command and General Staff College and the Army War College.

COL Joseph B. Starker heads the Directorate Charlie (Air Cavalry Combat Brigade), Modern Army Selective Systems Test, Evaluation and Review (MASSTER), Fort Hood, Tex.

From July 1969 to March 1970, he was the operations research analyst with the Support Weapons Systems Team, Infantry Systems Group, Weapons Systems Analysis, Office, Assistant Vice Chief of Staff, Washington, D.C.

COL Starker later served three months as operations research analyst with the Combat Vehicle Systems Team, Armored/Infantry Systems Group, Office of the Assistant Vice Chief of Staff.

Graduated from the University of Houston with a BBA degree in business administration, he has a master's degree in personnel administration from George Washington University. COL Starker has graduated from the Command and General Staff College and the Army War College.

COL George E. Turnmeyer is deputy commanding officer, U.S. Army Materiel Command (AMC), Europe. In July 1966, he was project officer, Office of the Special Assistant for Project Management, U.S. Army Materiel Command, Washington, D.C.

A graduate of the University of Maryland, COL Turnmeyer holds a BS degree in military science. His military schooling includes the Command and General Staff College, Armed Forces Staff College, and the Industrial College of the Armed Forces.

Army Signs $205 Million Contract For Safeguard System R&D Effort

The Army has signed a $205,759,991 contract for continued research and development on the Safeguard Ballistic Missile Defense System, consistent with Congressional action on the Safeguard program and provisions of the ABM Treaty with the Soviet Union.

Western Electric Co., prime contractor for the system, will share the award with numerous subcontractors throughout the nation. The contract was negotiated and signed by the Safeguard Systems Command, Redstone Arsenal, Ala.

Most of the work to be performed under the contract will be directed toward continuation of system tests at the Kwajalein Missile Range in the Pacific, development and testing of the system's Perimeter Acquisition Radar, and developing programs for system data processing equipment.

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mustard L5178Y/ASN^- were more pronounced when cells were exposed in culture than in the host-mediated assay probably due to the short reactive half-life of this agent in the aqueous environment of the mouse. The stable chromosomal complement is another valuable aspect in that concurrent cytogenetic and mutational studies can be performed. L5178Y/ASN^- was 80 times more sensitive to the mutagenic effects of sulfur mustard than several genetic markers in E. coli.

TITLE: The Frequency Response of a Pneumatic Tee Junction
AUTHORS: REDD and CARDILE
US Military Academy

ABSTRACT: The velocity amplitude frequency response of a pneumatic tee junction was experimentally determined over a frequency range of 100 to 1200 Hz using hot wire anemometer-linearizer instrumentation. An acoustic driver provided oscillating signals to a plexiglass tee junction of 1/4 inch x 1 inch rectangular cross section. The input, in-line, and branch legs were 2 inches long. The resulting experimental data is compared with analytical curves obtained from an ideal, acoustic, one dimensional model. Correlation is quite reasonable through the characteristic frequency of the junction.

TITLE: Theoretical Studies of High Energy Pulsed CO_2 Lasers
AUTHORS: CASON and KAST
Redstone Arsenal

ABSTRACT: A kinetic analysis of electron beam lasers has been developed. The model is a plasma dissipation input drift power calculation with the plasma production being controlled by an electron beam. The plasma production equations were coupled to the usual vibrational-mode balance equations and the stimulated radiation equation. This treatment resulted in a compact computer model suitable for use with the IBM 1620 machine. Predictions of pulse energy and pulse power time histories are in good agreement with experimental data. The model was used to design a 2 kilojoule/pulse electron-beam-controlled laser proposed to operate at 10-atmosphere pressure.

TITLE: Millimeter Wave Quasi-Optical Techniques for Device and Circuit Functions
AUTHORS: CHREPTA and JACOBS
Fort Monmouth

ABSTRACT: Optical integrated electronics is being considered for millimeter and far infrared wavelengths. With the advent of recently obtainable high resistivity silicon, low loss semiconductors offer an attractive potential as a dielectric guide material. In addition, because the guide is a semiconductor, it is proposed that devices and components can be "built in" the semiconductor transmission line. In effect one would have a low loss optical line with active elements incorporated. This concept would be particularly applicable in the region of wavelengths from millimeter waves to ten microns. An analysis has been made for the millimeter wave region which indicates that most of the energy flow is within the dielectric guide, and furthermore by conductivity modulation the electromagnetic radiation can be controlled. As a result, a new type phase shifter is proposed which can provide over one hundred eighty degree phase shift with practically no change in attenuation, and very little insertion loss. This would be applicable to phased array concepts. Other devices considered are amplitude modulators, generators, detectors, and directional couplers.

TITLE: Control of VEE Epizootic-Epidemic by Vaccine Developed at USAMRIID
AUTHORS: SPERTZEL and CROZIER
US Army Medical Research Institute of Infectious Diseases

ABSTRACT: In 1969, Venezuelan equine encephalomyelitis (VEE) erupted in Guatemala and spread into El Salvador, Honduras and Nicaragua. In

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1970, new outbreaks occurred in Costa Rica and in Mexico. As part of the effort to control these outbreaks, a live attenuated VEE vaccine, developed at USAMRIID for use in humans, was supplied. USAMRIID investigators provided technical assistance and assisted in field evaluation of the vaccine. Immunization of Equidae was highly effective in preventing equine deaths, and in limiting the outbreaks, but disease continued to spread sporadically into areas containing nonvaccinated equines.

VEE epizootics reached Texas in June, 1971. Within two weeks, the first human cases were recognized. The incidence of equine disease peaked by 25 July, although additional cases in nonvaccinated animals continued to appear for several months. The incidence of human cases increased sharply within the major epizootic area, peaking in mid-July.

Inoculation of Equidae was initiated on 27 June in South Texas and extended statewide in mid-July. Vaccine and technical guidance were observed only in nonvaccinated animals. Incidence of human cases declined precipitously as the vaccination program progressed and equine disease abated.

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TITLE: A Helium-Neon Laser Hit-Kill Simulator
AUTHORS: YORKS, WILSON, KRATSCHMER, ISAACSON and CURTIS
Fort Hood

ABSTRACT: In 1970 the Modern Army Selected Systems Test, Evaluation and Review (MASSTER) activity was tasked with testing and development of the TRICAP concept. It was desired that a system of laser weapons simulators be used in this testing to provide battlefield realism through attrition of the participants. After making a survey of the state-of-the-art of hit-kill simulators, a group of MASSTER engineers proceeded to design, build and test a Helium-Neon laser system. Financial and test schedule constraints dictated that the system be inexpensive and require a minimum of time to construct. It is not a complex, computer-controlled system, but consists of a laser, detectors, amplifier, encoder-decoder, line printer and vehicle mounts. The paper discusses the systems requirements and the decisions made to meet these requirements, to include: Selection of the Helium-Neon laser, photodiode detectors, weapons characteristics, simulation, laser modulation-demodulation, kill probability generation, output devices, vehicle mounts and eye safety. Systems shortcomings and problems are also discussed.

◆

TITLE: Dynamic Response Index Minimization For Personnel Escape Systems.
AUTHOR: DeSTEFANO
Frankford Arsenal

ABSTRACT: A study has been conducted on means of optimizing the ballistics of the catapult portion of rocket catapults employed in personnel aircraft emergency escape systems. Theoretical investigations, verified by experimental tests, have led to the development of a technique which, with minimum component modification and weight penalty, may be employed in current and future rocket catapult developments to reduce the injury probability for users of these systems. Probability of injury is determined by the dynamic response index which is a direct measure of the compression of the ejectee's spinal column which is caused by the longitudinally applied acceleration which would be experienced during the ejection sequence.

◆

TITLE: Structural Characterization of XP Films as Related to Mechanical Properties and Ballistic Performance
AUTHORS: DESPER, LEWIS, LOPATA, and ROYLANCE
Army Materials and Mechanics Research Center

ABSTRACT: XP is an experimental armor material made of laminated cross plies of thin, highly oriented polyolefin film which shows outstanding ballistic performance against fragment simulators. The un-

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Presidential Interns Doing Land Warfare Lab Research

Under a Presidential Internship Program, two young scientists sponsored by the National Science Foundation are developing research talents at the U.S. Army Land Warfare Laboratory (LWL), Aberdeen Proving Ground, Md.

Dr. Martin Lonky and William Wall have been working with the LWL Applied Chemistry Branch. They are investigating instrumentation developed for military use which also promises to be useful for determining sources of pollution in the environment.

LWL Commander COL Richard L. Clarkson said the purpose of the Internship Program is to provide promising researchers with a one-year association with federal laboratories.

The presumption is that the host organizations will benefit from the acquisition of new talent while the visiting scientists are developing greater potential for meaningful contributions to the social and economic goals of the nation.

Dr. Martin Lonky

William Wall

Born in New York, and presently residing in Newark, Del., Dr. Lonky received his BS

career programs

degree in physics at the Rensselaer Polytechnic Institute, Troy, N.Y., and MS and PhD degrees in solid-state physics from the University of Delaware.

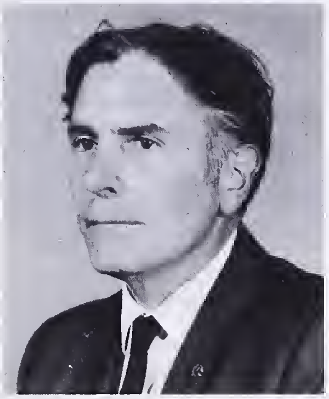
Dr. Lonky's research interests are in the physics and chemistry of solid-state and organic phosphors. He is a member of the American Physical Society and the Optical Society of America.

William Wall is a resident of New York State and received a BS degree in physics at Canisius College in Buffalo in 1964. He has done graduate work in solid-state research at Boston College and will shortly complete his doctorate requirements. He has conducted research on neutron scattering and fluorescence in solids.

He is a member of the Society of the Sigma Xi, an honorary research society, and the American Association of Physics Teachers.

CDEC Civilian Selected For National War College

Selection of Walter W. Hollis, scientific adviser to BG Ray Ochs, CG of the Army Combat Developments Experimentation Command, Fort Ord, Calif., to attend the National War College, Washington, D.C.. was announced in mid-July.



Walter W. Hollis

Relatively few civilians are selected to attend the NWC year-long course for the highly specialized training that enhances their qualifications for subsequent assignments to key management positions in the Department of Defense and other U.S. Government agencies. Hollis also will study simultaneously at Georgetown University for a master's degree in international affairs.

After receiving a BS degree in 1949 from Northeastern University in Boston, he did graduate work in physics at Boston University, and later was employed as instructor of physics at Northeastern until 1951.

Following 14 years of progressive experience in weaponry fire control, as R&D project engineer, he was employed three years as chief of the Combat Vehicle and General Instruments Laboratory at Frankford Arsenal, Philadelphia, Pa.

In July 1968, he became adviser to CDEC commanding generals, the highest ranking civil service employe at the Fort Ord complex. CDEC has the mission of scientific evaluation of concepts, organizations, tactics, techniques and application of equipment of the Army through experimentation.

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usual ballistic and mechanical behavior of XP arises from a unique semicrystalline microstructure characterized by a high degree of anisotropy. Fibrillar crystallites, comprising 65-70% of the material, are nearly perfectly aligned parallel to the stretch direction. Crystalline orientation functions of 0.990 to 0.997 (perfect orientation=1) have been determined, exceeding any value previously found in a polymer. The amorphous orientation function ranges from 0.4 to 0.8 depending upon processing conditions.

Amorphous orientation is a key factor influencing the mechanical properties of XP. The room temperature dynamic mechanical loss peak, attributed to amorphous phase motions, vanishes with increasing amorphous orientation. The sonic modulus at room temperature increases markedly with amorphous orientation in accordance with a series mechanical model. The correlation between ballistic performance and sonic velocity is attributed to the fact that the latter governs the rate at which energy is transmitted away from the point of impact. Thus sonic velocity offers a simple criterion for spot-checking ballistic performance in this class of materials.

TITLE: An Analysis of 5.56mm Aluminum Cartridge Case "Burn-Through" Phenomenon
AUTHORS: SQUIRE and DONNARD
Frankford Arsenal

ABSTRACT: The use of aluminum alloy as small arms cartridge case material is precluded by a catastrophic failure process previously identified as "burn-through". To determine engineering solutions which would enable the use of aluminum alloys, instead of the conventional cartridge brass, a combination experimental and theoretical program was undertaken to identify this failure process.

An analytical model was constructed from existing solutions of the physical processes occurring during "burn-through". The gas dynamics of flow in a small bore, boundary layer effects, transient heat conduction, and change of phase processes were all considered. Utilization of the analytical model allowed determination of the local temperature profiles and permitted the generalization that the failure process is ablation. Given gas flow, it was easily shown that portions of the aluminum cartridge case undergo melting. However, further use of the model demonstrated that the total amount of aluminum ablated from the cartridge case was not correctly predicted by a classified melting theory.

High speed motion pictures taken at the surface of the cartridge case showed the existence of a localized exothermic chemical reaction. When this additional energy source is considered together with the classically derived heat flux, the agreement between theory and experiment is excellent.

TITLE: An Intensive Approach to the Study of Materials Deterioration in the Tropics
AUTHORS: PORTIG, GAUGER, and DOWNS
US Army Tropic Test Center

ABSTRACT: Sixteen tropic test sites were established in typical subenvironments of the Canal Zone. At each site specimens of six chemically different materials were exposed. They were collected at constant and frequent time intervals and submitted to laboratory tests. In this way, typical deterioration histories were established.

Tensile strength of exposed materials was generally least reduced in the tropical forest and most reduced in open exposure, especially near the sea. Tropical deterioration cannot be explained in terms of atmospheric temperature and humidity, but rather in terms of solar radiation, drying and wetting processes, and ecology of the environment.

TITLE: Analytical Prediction of Vehicle Mobility
AUTHORS: DUGOFF

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US Army Tank-Automotive Command
RULA
US Army Engineer Waterways Experiment Station

ABSTRACT: The objective of the joint WES-TACOM Mobility Research Program sponsored by the US Army Materiel Command is the development of objective, performance-oriented methodology for the design, selection, and deployment of military vehicles. As a step towards that end, a comprehensive analytical model for evaluating the mobility of vehicle systems has been realized in a large-scale digital computer simulation. The model employs existing vehicle mechanics technology to predict individual facets of system performance, and new analysis and programming techniques to account for their synergistic interaction.

This paper describes the comprehensive model, discusses its promise and its limitations, and illustrates its application. The illustrations depict the various contexts and levels of detail in which the model can be applied, depending upon the mission of the user.

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TITLE: Filtering of Time Correlated Data
AUTHOR: DUNCAN
White Sands Missile Range

ABSTRACT: Assume that measurements $\{X_i\}$ have been made periodically at a set of times $\{t_i\}$ to provide information about some physical quantity, $X(t)$. Inasmuch as the $\{X_i\}$ contain experimental error, improved estimates of $X(t_i)$ can be obtained by means of a smoothing process, referred to as a filter. K^2, the smoothing factor of a filter is expressed as a ratio of input to output data variances. Conventional filter theory assumes that the errors, $\{\delta X_i\}$, are uncorrelated. This assumption is not met in practice if the time interval between measurements is small. This paper assumes that the errors are correlated in accordance with $C(\tau) = \sigma_X^2 \exp[-\omega|\tau|]$. Under this assumption K is asymptotically independent of sample rate in the case of a non-recursive filter. Conventional theory predicts $K \sim r^{-1/2}$ for large rate. In the case of a recursive filter the usual assumption leads to an optimum data rate of infinity. Accounting for correlation in the data leads to a finite result for the optimum data rate.

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TITLE: Development of Multipurpose Water Purification Unit for Army Field Use
AUTHORS: FORD, and LINDSTEN
US Army Mobility Equipment R&D Center

ABSTRACT: It is essential that the US field Army be provided with potable drinking water for culinary, washing, bathing, laundering, and food preparation purposes. Water treatment equipment currently available in the Army supply system has the capability of producing potable water from polluted fresh water; sea water; certain brackish waters; and water contaminated with chemical, biological, and radiological agents. However, in view of inherent complexity, and in pursuit of improved reliability and efficiency, Army R&D is attempting to demonstrate the technical feasibility of a single multipurpose water purification process. Reverse Osmosis is the prime candidate. Reverse Osmosis is a membrane process which passes pure water while leaving particulate matter and most soluble material behind. The United States Army Mobility Equipment Research and Development Center is conducting a concerted R&D program to utilize the reverse osmosis principle in the development of a universal field water purification unit.

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TITLE: A Parametric Analysis of MARS vs the 8-Inch Howitzer
AUTHOR: FRANKS
Fort Hood

ABSTRACT: This paper (with classification of Secret) compares the

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Women in Army Science

Dr. Ransohoff Chosen President Of Federally Employed Women

Dr. Priscilla Ransohoff, Army Electronics Command Research and Development Directorate, was elected national president of Federally Employed Women during FEW's recent third convention in Washington, D.C.

A graduate of the University of Pittsburgh, she holds master's and doctorate degrees from Columbia University. In addition to her Federal Civil Service job, she is on the teaching staff of Brookdale Community College and Ocean County College, Fort Monmouth, N.J.

Fort Monmouth's chapter of FEW was organized in 1968 while Dr. Ransohoff was serving as the E-Command's coordinator of the Federal Women's Program. She is a founding member of national FEW and a member of its national Board of Directors.

Dr. Priscilla Ransohoff

Dr. Ransohoff is a member of two honorary education societies, a life member of the National Education Association, and is listed in *Who's Who of American Women.* In 1970 she was elected Woman of the Year by the Monmouth County Business and Professional Women's Organization.

APG Female Mathematician Receives GS-13 Rank at 27

Promotion to GS-13 supervisory mathematician recently made Mrs. Richard D. Meyer, who not long ago celebrated her 27th birthday, the youngest of six female supervisors at the U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.

Assigned to the Analysis and Programing Division, Systems Engineering and Computation Support Office, Mrs. Meyer is also among the newest of the MERDC's 321 women employes, having joined the center in 1970.

Mrs. Meyer entered Federal Civil Service in 1968 soon after graduating from the University of Wisconsin with a master's degree in mathematics. She has a daughter, Teresa Ann, but the dual responsibility of being a wage earner and a housewife has not deterred her from doing graduate work in statistics at George Washington University in Washington, D.C.

Homer J. Chigos Jr., Equal Employment Opportunity Officer at the center, said Mrs. Meyer's selection for promotion is part of the response to President Nixon's April 1971 call for an increase in the number of women in supervisory positions ranging from GS-13 through GS-15. In her comparatively short tenure with the MERDC, she has demonstrated outstanding professional competence.

Mrs. Richard D. Meyer

LTC Knox Becomes Chief Of ANC Assignment Branch

LTC Edith V. Knox is the new chief of the Assignment Branch, Army Nurse Corps (ANC) Career Activities Branch, Personnel and Training Directorate, Office of the Surgeon General, following completion of her residency training at Silas B. Hayes Hospital, Fort Ord, Calif.

A member of the American Nurses' Association and the National League of Nursing, she began her ANC career in 1953 and has served in Hawaii, Germany, Korea and Vietnam. She was chief nurse at the 67th Evacuation Hospital in Vietnam.

LTC Knox is a graduate of Parkland Hospital School of Nursing, Dallas, Tex., and was awarded her BS degree in nursing from the Incarnate Word College, San Antonio, Tex. She received her MHA through the U.S. Army advanced education program with Baylor University.

She has been awarded the Bronze Star Medal, the Meritorious Service Medal and the Army Commendation Medal.

Army Nurse Is First Woman Of AMD Selected for AWC

LTC Doris Sue Frazier is the first Army nurse and first woman of the U.S. Army Medical Department selected to attend the Army War College, Carlyle Barracks, Pa. She has served since 1970 as assistant to the chief of the Army Nurse Corps (ANC).

Graduated from St. Luke's Hospital School of Nursing in Kansas City, Mo., she has a BS degree in nursing education from the University of Minnesota and a master's degree (with honors) in health administration from Baylor University.

She began her Army career with the Nurse Corps in 1949, attaining the distinction of being the first ANC Officer to graduate from the Army's Command and General Staff College regular course in 1967.

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proposed Multiple Artillery Rocket System (MARS) with the improved 8-inch howitzer, M110 E2. The primary measure of effectiveness is the numbers of each type warhead (ICM) meeded to inflict thirty percent casualties on personnel and tank targets. This is done for open terrain and for target arrays in which ranges from FEBA and target radius are varied. A clear superiority is demonstrated for one system against personnel targets. Conclusions are also drawn about the effectiveness of both systems against tank targets.

This paper is written for a military reader without a scientific background. The mathematical rationale is presented as an appendix rather than in the body of the paper. Attention is focused on the key assumptions and parameters which drive the study. The rationale for each assumption is explained, permitting the reader to evaluate these assumptions before accepting the conclusions. A discussion of system parameters highlights those to which study conclusions are sensitive as well as providing insight into the utility of the proposed system.

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TITLE: Miss Distance Radar - A Development for Air Defense Weapons Testing
AUTHOR: FRENCH
US Army Air Defense Board

ABSTRACT: The measurement of vector miss distance is essential in development, test and evaluation of air defense weapons. The Miss Distance (MIDI) Radar is being developed to meet this requirement.

Based on well established radar technology, the system uses a four-horn monpulse target tracking radar with a series of range gates to measure the target position in space and the missile position relative to the target. It uses a mini-computer to provide post-flight analysis within one minute of the test.

This paper discusses the requirement, concept, early experimental work, live firing test results, and the final development of a dedicated miss distance radar system.

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TITLE: The Measurement and Analysis of Fatigue Crack Growth in Thick-Walled Cylinders
AUTHORS: MILLER, WINTERS and FUJCZAK
Watervliet Arsenal

ABSTRACT: Thick-walled cylinders exposed to repeated cycles of high internal pressure, may fail by low-cycle fatigue. The fatigue life of these cylinders is primarily a function of the crack propagation rate. The portion of fatigue life consumed in crack initiation may be considered an additional safety factor. To develop design criteria and to set safe inspection standards, it is necessary to know not only the length, but the depth and shape of fatigue cracks.

A technique has been developed for the accurate measurement of crack depth in thick-walled cylinders using a straight-beam ultrasonic probe. This technique has proved useful not only under laboratory conditions, but also in practical situations such as inspection of cannon tubes after firing. Various aspects of the technique such as accuracy and sensitivity are presented.

In the presence of multiple cracks, the measurement, recording and analysis of all the factors of fatigue crack growth can be quite complicated. To alleviate this problem a system for the rapid collection, reduction, and analysis of this data by computer has been developed. The resulting measuring devices, the data acquisition system and the link to an IBM 360 computer is described.

Various computer programs used to process the data and illustrating the kind of information and graphical output that can be generated are described. This includes a graphic representation of all the cracks present showing their location and depth. The importance of the rapid

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data analysis feature of the system to apply fracture mechanics theory for the control of the fracture process in thick walled cylinders is demonstrated.

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TITLE: Friction of Poly(n-Alkyl Methacrylates)
AUTHORS: GISSER and PETRONIO
Frankford Arsenal

ABSTRACT: The friction coefficient of solid poly(n-alkyl methacrylates) decreases progressively with increasing length of the alkyl group. This behavior parallels the behavior of adsorbed films of these polymers from solution on solid surfaces. Durability of thin films of these polymers (approx. 3500Å thick) increases with increasing length of alky group. For example, when the alky is C_{22} the durability is four times greater than when the alkyl is C_{12} (polymer film on a 1020 steel substrate). The film durability is strongly substrate dependent, e.g., durability of poly(n-dodecyl methacrylate) is three times greater on glass than on 1020 steel when rubbed with a 440C rider. The friction and durability are attributed to side chain crystallinity of the polymer. Side chain crystallinity has been observed by others using x-ray and other techniques when the alkyl group is at least 10 or 12 carbons long. Friction measurements may be a more sensitive way of detecting side chain crystallinity. The friction behavior of adsorbed films from solution of the poly(n-alkyl methacrylates) suggests that side chain crystallinity also pertains to such adsorbed films.

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TITLE: Dynamic Compatibility of Helicopter Propulsion Systems
AUTHORS: VANCE and GOMEZ
US Army Air Mobility R&D Laboratory, Eustis Directorate

ABSTRACT: A study of problems related to vibration and dynamic loads in helicopter propulsion systems has been made. It has been found that engine vibration, shaft whirling, and dynamic instabilities seriously limit helicopter performance and reliability. Significant improvements in these two areas can be obtained in turboshaft-powered helicopters by improving the dynamic compatibility of engines, drive shafts, and transmissions with each other and with the airframe. Specific research and development is prescribed in four subareas: (1) establishment of more realistic and meaningful vibration limits for turboshaft engines in helicopter applications, (2) development of better methods for engine/airframe interface design and analysis, (3) use of more realistic analytical models of shaft-coupling dynamics, and (4) development of improved methods for torsional stability analysis of helicopters drive trains with automatic Fuel control.

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TITLE: Infrared Mine Detection
AUTHOR: GRAVITTE
US Army Mobility Equipment R&D Center

ABSTRACT: Early investigations of infrared phenomena showed that the soil surface overlaying a buried mine is warmer during mid-day and cooler during early morning hours than an undisturbed soil surface. This temperature difference is caused by the mine which has a thermal conductivity less than that of soil.

Several state-of-the-art military thermal imaging systems have been tested and evaluated for the mine detection role. Conclusions deduced from these tests are that (1) hand-held imagers have a significant potential for mine detection, (2) the tank-mounted imager has limited application for mine detection as presently mounted, (3) ground-based imagers appear to offer more promise for the mine detection role than airborne imagers, and (4) the factors limiting the usefulness of thermal imagers for mine detction are inappropriate system implementation and absence of the IR phenomena during unfavorable climatic situations.

Programs are underway to develop concepts of a vehicle-mounted system

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Awards . . .

EXCEPTIONAL CIVILIAN SERVICE. Deputy and Scientific Director of Army Research *Dr. Richard A. Weiss,* who held that title since the establishment of the Army Research Office in March 1958, was awarded the Decoration for Exceptional Civilian Service—the U.S. Army's highest award for civilian employes—when he retired June 30 to end more than 31 years of Federal Civil Service employment.

Dr. Weiss, whose career started with the Army Signal Laboratories (now the Electronics Command Laboratories) at Fort Monmouth, N.J., was cited for "extraordinary dedication of purpose, his mature wisdom, astute judgment and his distinguished leadership" in the Army Research and Development Program.

CERTIFICATES OF RETIREMENT presented by Army Chief of R&D LTG William C. Gribble Jr. gladden (from left) Mrs. Cora Watson, Mrs. Sally Kennedy and Deputy and Scientific Director of Army Research Dr. Richard A. Weiss, veteran Army Research Office employes. Dr. Weiss was presented the Decoration for Exceptional Civilian Service by Army Director of Research BG Charles D. Daniel Jr. at a subsequent ceremony. All three received farewell Outstanding Performance Ratings. Mrs. Watson served as secretary to Dr. Weiss since the 1958 inception of the Army Research Office.

In commenting on his "broad comprehension, sound analytical approach and sensitivity to nuances that affect the Army R&D activities," the citation states that "his ability to inspire confidence has resulted in excellent relations with executives in the Army, other Services, and foreign nations. . . ."

Dr. Alexander Hammer, director of the Army Weapons Command Research Laboratory, was awarded the Decoration for Exceptional Civilian Service for his contributions to the development of a "unique laboratory," the Keith L. Ware Simulation and Experimental Firing Center, at Rock Island (Ill.) Arsenal.

WECOM Commanding General (MG) H. A. Rasmussen presented the award. The citation comments that the laboratory provides "a new capability for advanced mathematical model and simulation of small and medium caliber weapons systems based on latest technological advances in analytical and computerized techniques. . . . Dr. Hammer conducted an outstanding research program involving major tasks that removed barriers to contemporary design problems of the greatest urgency. . . ."

MERITORIOUS CIVILIAN SERVICE. *Orley R. Bourland Jr.* recently received the Meritorious Civilian Service Award (MCSA) for his accomplishments during 17 months as Demilitarization Program coordinator for the U.S. Army Munitions Command (MUCOM).

COL Frank C. Schoen, chief, Munitions Systems Office, MUCOM, presented the award. The citation praised Bourland for his professionalism in an assignment that kept him under close scrutiny nationally and internationally.

Bourland is presently serving as administrative officer for the Etiology area of the National Cancer Institute at Fort Detrick.

Helen Jordan is a recent recipient of the MCSA for her contributions as chief, Security Branch, Office of the Surgeon General. COL R. E. Adams, MSC, the Army Surgeon General's executive officer, presented the award at Mrs. Jordan's retirement ceremony.

LEGION OF MERIT. *LTC Edward J. Bunn,* Plans Division, Net Technical Assessment Team, OCRD, HQ DA, recently received the Legion of Merit (LM) for 1971-72 service as chief, Plans Division, G-3, XXIV Corps, Vietnam.

COL William A. Boyson, MC, director, Personnel and Training, Office of the Surgeon General, has been awarded the 2d Oak Leaf Cluster (OLC) to the LM. He was cited for 1968-69 exceptional performance as deputy surgeon, U.S. Army, Japan, and during 1969-71 as CO, U.S. Army Medical Command, Okinawa, CO, U.S. Army Hospital, and surgeon of the U.S. Army Ryukyu Islands.

COL Enrique Mendez Jr., MC, received the first OLC to the LM for two years service as chief, Medical Corps Career Activities Division, where he handled the assignment and career development of all physicians on duty with the Army Medical Corps.

MERITORIOUS SERVICE MEDAL. *MAJ William C. Miller,* III, MSC, recently received the Meritorious Service Medal (MSM). The citation praised MAJ Miller for performance as executive officer, Medical Intelligence Office (1969-72).

COL Dan Crozier, MC, CO of the U.S. Army Medical Research Institute of Infectious Diseases, Fort Detrick, Md. was awarded the MSM for his exceptional achievements in an Army Veterinary Equine Encephalomyelitis (VEE) program in 1971. Results helped to check an epidemic of the disease in Mexico and the Southwestern U.S. in 1971. COL Crozier and LTC Richard D. Spertzel, an Army MC associate, were honored with "superior service" plaques presented by the U.S. Secretary of Agriculture.

COL Thomas G. Murnane, VC, chief of the Veterinary Research Division, HQ, U.S. Army Medical Research and Development Command, also received the MSM for similar support for foreign and national VEE programs since 1968.

AIR MEDAL. *CPT Herbert W. Head,* Physical and Engineering Sciences Division, Army Research Office, Office of the Chief of R&D, HQ DA, is a recent recipient of Numerical Device "1" to the Air Medal (AM). The award, which honors CPT Head for his performance as a helicopter pilot in Vietnam,

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that will maximize the usefulness of the phenomena and thermal imagers for the mine detection role.

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TITLE: Optimum Bullet Study

AUTHORS: MAC ALLISTER, REITER, GROLLMAN, ROECKER and THRAILKILL
Aberdeen Proving Ground

ABSTRACT: A study is being conducted, and is partially completed, on the design of small arms projectiles. The goal is to be able to predict interior, exterior, and terminal ballistic performance given shape, material properties, and aerodynamic coefficients. Projectile shapes ranging from that of conventional bullets to flechettes are being investigated. The study has been broken into two phases; first, interior and exterior ballistics, second, terminal ballistics and vulnerability. Perhaps the most significant departure from previous studies was the inclusion of a base drag reducing mechanism involving heat or mass addition. The inclusion in the study of base drag reduction permitted the consideration of shapes, such as cone flares, which would not ordinarily be considered because of their high base drag.

Trajectory calculations were made parametrically with recoil momentum being the prime constraint. Momentum was used because the principal non-ballistic error in hit probability is the aiming error which decreases with decreases in momentum. The calculations showed that base drag reduction contributed significantly to projectile performance where down-range celocity or energy was a measure of effectiveness.

◆

TITLE: Mandibular Bone Grafts with Surface Decalcified Bone

AUTHORS: JONES, LILLY, OSBON and HACKETT
Letterman Army Institute of Research

ABSTRACT: This study was undertaken to determine the results of combining surface decalcified allogenic bone (SDAB) and autologous hemopoietic marrow (AHM) as a mandibular bone graft. Bilateral defects of comparable size were created in the lower border of the mandibular body in 9 dogs. One defect in each animal was filled with AHM supported with a Vitallium® mesh crib lined by a Millipore® filter. The defect on the opposite side was restored with AHM supported by SDAB secured with transosseous wires. Animals were sacrificed at 1, 2, 3, 4, 5, 6, & 7 weeks after grafting. Haematoxylin-eosim histologic sections revealed active osteogenesis in all specimens. There was fusion of the SDAB to host bone observed at 2 weeks with progressive osteogenesis in later specimens. Osteogenesis was apparent and progressive in the AHM portions of the grafts from 2 weeks. Osteoclastic activity was observed in the SDAB portions of the grafts and no evidence of rejection was noted. In specimens supported by Vitallium® mesh and Millipore® filter, osteogenesis was delayed in the areas adjacent to the filter and limited by the metal framework. Although pure AHM grafts appear to have osteogenic potential, they do not have allostructural support and thus require additional support. The SDAB-AHM graft may have advantages over AHM grafts supported by metallic frameworks.

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TITLE: A Heat Stable, Highly Sensitive Enzyme for Detection and Identification of Nerve Agents

AUTHORS: KRAMER, MICHEL, SWAIN and HACKLEY
Edgewood Arsenal

ABSTRACT: A heat stable esterase has been isolated from cultures of Bacillus stearothermophilus and characterized with respect to physical and biochemical properties. Its stability up to a temperature of 70°C and high alkalinity is remarkable. Moreover, it is highly useful for the specific identification and detection of G agents as a class at extremely low concentrations.

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TITLE: ARMIDOP/ZERO-DOP Positioning Technique

AUTHOR: HANNIGAN
US Army Engineer Topographic Laboratories

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ABSTRACT: This paper describes a new and unique technique for locating tactical positions on the battlefield. It can be used to locate artillery forward observers, patrols, command posts, units of any size, even remote sensors.

The acronym ARMIDOP/ZERO/DOP stands for ARmy (or ARtillery) MIssile DOPpler/ZERO-DOPpler. These words identify the military items and the basic physical parameter necessary for the implementation of this positioning technique.

The initial research was performed entirely in-house at the Research Institute of the US Army Engineer Topographic Laboratories. This included a rigorous analysis using computer simulation and modeling to determine theoretical feasibility. The performance requirements of hardware to implement the technique were also determined. The US Army Engineer Topographic Laboratories, where the concept originated, and the US Army Harry Diamond Laboratories, noted for their technology in gun-rugged electronics, are now working jointly on this tactical positioning technique. Details of this original technique are classified Confidential.

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TITLE: A Stochastic Network To Model Air Cargo Terminals
AUTHORS: PORTE, HAPP, LEE, and McNAMEE
Construction Engineering Research Laboratory

ABSTRACT: Cargo flow through an air cargo terminal is modeled as an activity network by utilizing: (a) deterministic and probabilistic decision-making elements as nodes, (b) activities or branches which relate the nodes and whose characteristics determine the magnitude and delay of commodity flow, and (c) a set of statistical monitors to count events and to perform statistical evaluations at strategic points of the network.

Bottlenecks of the material handling operation of an air cargo terminal are investigated by the stochastic network method of GERT IIIQ. The relationship of the GERTS IIIQ network model to construction specification is discussed. Operations bottlenecks are identified and corrected through modification of facility constraints.

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TITLE: Deformation and Fracture of Tank Bottom Hull Plates Subjected to Mine Blast
AUTHOR: HASKELL
Ballistic Research Laboratories

ABSTRACT: Analytical methods have been developed for predicting the deformation and fracture characteristics of flat rectangular tank bottom hull plates subjected to blast attack from shallow-buried mines located under the plate's center. The methods developed do not require electronic digital computers in their application, and are easy to use, and directly applicable tools for vulnerability assessments and engineering design.

Predictions of the deformation and fracture equations correlate within an average error of 18 percent and 10 percent respectively with available aluminum and steel plate mine blast test results. Furthermore, predictions of the fracture equation correlate within 12 percent with data from armored vehicles damaged by mine blast in combat.

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TITLE: Molecular Orbital Theory as Applied to Fulvene Reactions
AUTHOR: HENRY
Office of the Chief of Research and Development

ABSTRACT: It is the purpose here to examine the molecular orbital treatment of fulvenes in order to demonstrate the correlation of nucleophilic and electrophilic attack on fulvene compounds with the substitution predicted by HMO calculations. There is a particular reaction of fulvenes which has aroused much interest ever since it was first observed by Thiele and Balhorn in 1906 (3). They found that the

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awards

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where he flew 25 aerial missions in 1969-70 as Communications officer of the 5th Bn, 60th Infantry, 3d Brigade, 9th Infantry Division, was presented by Director of Army Research BG Charles D. Daniel Jr.

ARMY COMMENDATION MEDAL. *SP5 David Lyzinski* is a recent recipient of the Army Commendation Medal (ARCOM). He was cited for "exceptionally meritorious service" as a chemical engineer at the U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.

OUTSTANDING PERFORMANCE RATINGS. Director of Army Research Office BG Charles D. Daniel Jr. recently presented Outstanding Performance Ratings to Dr. Richard A. Weiss, Deputy and Scientific Director; Dr. Ivan R. Hershner Jr., Dr. Thomas E. Sullivan and Dr. James I. Bryant of the Physical and Engineering Sciences Division; Miss Jo Ann Cole, Adjutant's Office; Mrs. Lela A. DeTemple, Research Support Division; Dr. Robert J. Heaston and Mrs. Sally C. Kennedy, Science and Technology Division; Dr. Guy N. Parmenter, Environmental Sciences Division; and Mrs. Janice B. Sexton, Office of the Assistant Director of Army Research.

CDEC Honors 2 Personnel For Special Accomplishments

The Army Combat Developments Experimentation Command (CDEC), Fort Ord, Calif., recently honored two of its personnel with special new awards.

CPT Alexander J. Fox, project analyst, Methodology Division, Office of the Deputy Chief of Staff for Plans and Programs has been chosen "Officer of the Year." The citation notes "exemplary professionalism and initiative in accomplishing simultaneous diverse projects under adverse time constraints."

In addition, he authored technical papers on the application of statistical analyses and methodologies for use by untrained staff officers.

SP/4 Raymond A. Povirk, attached to Company F, 41st Infantry, Experimentation Battalion, Experimentation Brigade of CDEC, was selected as "Soldier of the Year." Specialist Povirk, according to the award citation, "exhibited high merit in his responsibilities." His duties included operating ranges, maintaining communication networks, supervising the communication control center, and serving as chief radio and telephone operator-coordinator for the XM-19 Serial Flechette Rifle Evaluation experiment.

ABMDA Scientist's MORS Paper Selected for David Rist Award

Herbert Cohen, a key staff member of the U.S. Army Advanced Ballistic Missile Defense Agency (ABMDA), Office of the Chief of R&D, HQ, DA, is coauthor of a research paper recently selected for the 28th MORS (Military Operations Research Symposium) David Rist Prize.

Titled "Methodology for Minimizing the Deployment Cost of Hardsite Ballistic Missile Defense Systems," the paper was prepared in conjunction with Dr. Stanley Dick and Willard Perry, Keystone Computer Associates.

Their work systemizes a complex set of interactive aspects of a large-scale system. The awards committee terms their approach as "innovative, having the capacity to relate a wide variety of totally different technologies to the crucial problem of ballistic missile defense."

Objective of the David Rist Prize is to provide recognition to authors of outstanding papers at the Military Operations Research Symposium. To qualify for consideration, papers must be classifiable as "true operations research or systems analysis; pertinent to real problems of military planning, operation or management; and clear, logical and cohesive."

Hartman Gets Sloan Fellowship For MIT Management Studies

Dr. Richard L. Hartman, an Army Missile Command research physicist, has been selected for an Alfred P. Sloan Fellowship at the Massachusetts Institute of Technology.

Dr. Hartman joined 48 other young executives from industry, government, medical and health services when classes began in June. He earned his college degrees, including his PhD, at Carnegie Institute of Technology.

The Sloan Fellowship Program, started in 1931, provides mid-career executives a year of advanced management study leading to a master's degree in management. Candidates are nominated by their organizations and selected by MIT.

The Sloan Fellows at MIT study foreign policy, law, labor relations, finance and taxation, economics, and other courses. In addition to classroom work, the group will meet with top officials in industry and government.

Dr. Hartman came to Redstone Arsenal in 1965 and has been employed since that time by the Directorate for Research, Development, Engineering and Missile Systems Laboratory. He works in quantum electronics in the Physical Sciences Directorate.

Active in several professional and civic organizations, he has published a number of technical articles and research reports, and in 1969 was among recipients of the annual Army Research and Development Achievement Award.

Dr. Richard L. Hartman

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combination of dimethylfulvene and acetone, in the presence of sodium ethoxide, yielded an oily, reddish-orange substance which analyzed for $C_{14}H_{20}O$. This structure was confirmed by a combination of physical methods, and by chemical degradation to a known compound. In addition to the above product a higher boiling condensate was obtained from the reaction but not identified. The assigned structure is undoubtedly correct, the suggested mechanism is questionable, and the application of molecular orbital theory predicts a more plausible path as well as providing theoretical substantiation to the proven structure. In addition molecular orbital calculations predict a possible structure for the unidentified higher boiling condensate.

◆

TITLE: Ice Forces on Vertical Piles
AUTHORS: NEVEL, PERHAM, and HOGUE
US Army Cold Regions Research and Engineering Laboratory

ABSTRACT: The force that floating ice can exert on vertical piles is important to the design of both military and civilian structures. Present designs assume 400 psi as the crushing strength of ice without regard to other influencing factors and their variations. The purpose of these tests was to find the influence of pile shape and size, and ice speed, temperature, salinity and thickness upon the ultimate load that ice can exert on a pile.

The tests were made in a 20 ft x 20 ft cold room filled to a depth of 4 feet with sea water. Up to 8 inches of ice was grown and vertical piles were pushed horizontally into the ice sheet at uniform speeds up to 19 inches per second. Cylindrical, flat, and wedge-shaped piles were tested. They varied in width from 1½ to 36 inches.

Five different failure modes were observed: crushing, buckling, bending, creep, and splitting. A movie was made of these failures and other observed phenomena.

◆

TITLE: A Means of Inducing Variable Swirl and Increased Engine Efficiency in the Stratified Charge Wankel Engine
AUTHOR: HOON
US Military Academy

ABSTRACT: Two design modifications for the stratified-charge, spark ignition wankel engine are proposed. One is aimed at improving air swirl rates; the other is aimed at improving low-speed, no-load operation.

An intake port employing high pressure exhaust gases and a fluidics proportional amplifier configuration are proposed to allow for variable control air swirl in one or two planes.

A T-shaped rotor pocket and dual fuel injectors independently operated are proposed to maintain good high speed operation and improve low-speed, no-load operation.

Key Words: Air pollution, engine performance, exhaust-gas-recirculation, local fuel-to-air ratios, proportional amplifier, stratified charge, swirl, wankel engine.

◆

TITLE: Oscillatory Behavior of Detonating Solid Explosives
AUTHORS: HOWE and MELANI
Aberdeen Proving Ground

ASTRACT: Structural details of the detonation waves in pressed and cast high explosives were studied. An experimental technique was devised whereby pressure fluctuations in the detonating high explosive were monitored as functions of position and time. Streak and open shutter photographs of the explosive events showed that condensed phase detonations have a remarkably high degree of oscillatory behavior, in spite of explosive granularity. It was shown that the complete struc-

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tural phenomenology of gaseous detonations is extendable to the condensed phase.

Peculiarities of the solid state are manifested in a strong dependence of cell size upon loading density and granularity. For "steady state" conditions, i.e., when the detonation propagates with a time-average steady (Chapman-Jouguet) velocity, a unique cell pattern exists for each set of initial and boundary conditions. However, when the detonation state variables are allowed to change, as during buildup, failure, or other transient stages, the cell pattern readjusts slowly, and a unique cell pattern does not correspond to each state variable set.

The fact that confinement is not necessary for the existence of transverse waves and the fact that neither spacing nor direction of wave trajectories is appreciably affected by intersection with waves of the opposite family indicate that the transverse waves are a manifestation of, and not the cause of, the oscillatory instability.

◆

TITLE: A New Approach to Digital Signal Detection
AUTHOR: HUBER
Fort Monmouth

ABSTRACT: A new approach to digital signal detection has been proposed that offers advantages over conventional threshold detection by providing improved reception in the presence of noise. The basic concept of the new digital detector is that of waveform classification. Waveforms are classified by using preprocessing techniques that minimize the degradation effects of noise. This is accomplished by encoding the preprocessed data into binary digital words that are classified with statistical weighted networks. These networks are weighted by a statistical correlation technique that uniquely tailors the system to produce the required signal dichotomy.

This paper describes the basic digital detector concept and how its features (including low noise sensitivity, multiple data sampling, and statistical correlation by weighted networks) are utilized to provide increased signal detection reliability in the presence of noise. A computerized method is presented for designing weighted networks that are statistically matched to system characteristics. While the method is demonstrated on communications data, it has general application to other fields. Results of laboratory tests on the new digital detector are discussed and its error correcting features examined.

◆

TITLE: Response of Cylindrical Shells to Traveling Load Simulation of X-Ray Blow-Off Impulse
AUTHORS: HUFFINGTON and WORTMAN
Aberdeen Proving Ground

ABSTRACT: The use of surface-applied sheet explosive to simulate blow-off inpulse loading of shell structure has been questioned because it cannot be detonated simultaneously but must be initiated as a plane or curved detonation front which sweeps over the structure. To clarify this matter, a study was conducted in which the lethality-level responses of fixed-ended cylinders to a "frontal cosine" distribution of impulse intensity were calculated for three loading modes: (a) a simultaneously initiated blast pulse, (b) a plane detonation front sweeping longitudinally and (c) a plane detonation front sweeping circumferentially. These calculations were performed using the REPSIL code which employs a finite difference approach to treat the large deflection, elastoplastic response of thin shells. It was concluded that the circumferentially sweeping detonation front provides an unsatisfactory simulation of X-ray loading but the longitudinally running blast wave is acceptable if certain requirements are met.

◆

TITLE: "Hand-Held Laser Rangefinder (AN/GVS-5)"
AUTHORS: NEWTON, KOBYLARZ and TUTTLE
Fort Monmouth

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Preston Receives CG Award For Support System Process

MAJ Edward G. Preston, Army Combat Developments Experimentation Command (CDEC), Fort Ord, Calif., is the recipient of The Commanding General's Award for 1972, presented annually to the individual who has contributed most to improvements in the combat developments process.

MAJ Preston was recognized for his achievements in designing and developing the computer programing support system for casualty assessment routines used by CDEC in Experiment 43.6, Attack Helicopter-Daylight Defense experimentation.

As chief of the computer division, Office of the Deputy Chief of Staff for Instrumentation, he was also responsible for the design and modification of computer software routines to extract selected data for post-trial analysis.

MAJ Edward G. Preston

Logistics Management Center Picks Essay Contest Winners

Three winners in the 1972 annual essay contest sponsored by the U.S. Army Logistics Management Center (ALMC) were awarded prizes of $300, $200 and $100.

Richard Cohen, a supervisory supply systems analyst at the Defense Industrial Supply Center, Philadelphia, Pa., won first prize by writing on "Defense Management Training: A New Direction."

Glenn G. Boyer, Headquarters, Strategic Communications Command—Pacific, received the second place award for "Management Metaphysics."

CPT Terry A. Girden, Army ROTC Instructor Division at St. Lawrence University, N.Y., won third prize for "Organizational Theory and the Military."

Designed to stimulate efforts for improved management in the Armed Forces, the essay contest is open to all members of the military services, including the Reserve Components and National Guard, and civilian employes of the Department of Defense, except members of the ALMC staff and faculty.

awards

Personnel Actions . . .

Nixon Selects Abrams As Army Chief of Staff

General Creighton W. Abrams Jr., who in 1968 departed a 4-year assignment as Army Vice Chief of Staff to succeed General William C. Westmoreland in Vietnam, has returned to succeed him again as Army Chief of Staff upon his retirement from military service. At press time, Senate confirmation was pending.

GEN Creighton W. Abrams Jr.

President Nixon nominated General Abrams in an announcement commending his outstanding service for four years as CG of the U.S. Army Vietnam and also the U.S. Military Assistance Command in Vietnam. Senate confirmation was pending as the *Army R&D Newsmagazine* went to press in mid-July.

Promoted to general in September 1964, Abrams became Vice Chief of Staff after serving since August as acting VCS. That assignment followed a tour of duty as CG of V Corps in Germany, preceded by duty in the Pentagon as Deputy Assistant Chief of Staff for Force Development.

GEN Abrams was graduated from the United States Military Academy in the Class of 1936 and commissioned a second lieutenant in the Cavalry, but a significant part of his career has been served with Armor troops.

During World War II, he served with the 4th Armored Division from its activation in 1941 until VE Day in 1945 in the progressive roles of regimental adjutant, regimental executive officer, battalion commander, and combat command commander.

GEN Abrams returned to the States for an assignment with the War Department General Staff, serving on a board to determine Army post-independence base requirements in the Philippines, and then in the Plans Section of the Army Ground Forces.

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ABSTRACT: The hand-held laser rangefinder, AN/GVS-5, is the first practical and accurate target acquisition device to replace the binoculars commonly used by the foot mobile soldier. The creation of this device was made possible by the harmonization of such diverse technologies as optical detection, micro-electronics and lasers. Two generations of these devices have been developed, one showing technical feasibility and the other demonstrating economic feasibility. As a result of these efforts, a broad technical base for laser rangefinder design has been established.

◆

TITLE: Development of Dynamic Model for an Aircraft Gun Turret System

AUTHORS: HUNG, WONG and TOWNSEND
US Army Weapons Command

ABSTRACT: This paper presents the effort in the model structuring phase and the formulation phase for the development of a dynamic model of a conceptional helicopter gun-turret system. The model is intended for application in preliminary design.

The system considered comprises functional subsystems such as turret drum assembly, elevation and slew control assemblies, gun mount, feed and receiver assemblies, and gun barrel. The overall system configuration, which has a direct fire automatic gun, with soft recoiling firing cycle, resembles XM120 system.

The system is first envisioned as a discrete, lumped parameter system. Lagrangian approach is then taken to obtain the system equations of motions and dynamic constraints. These analytical results render the dynamic behavior of the system under two different constrained situations at the support point of the gun-turret system - (a) flight dynamic constraints, and (b) force and moments constraints.

A special purpose program-FORMAC is used to overcome the algebraic complexity. It is noted that specific tailorings of formulations are necessary prior to algebraic manipulation on a computer.

◆

TITLE: Analysis of Band Pressure in A Gunn Tube Using Finite Elements and Shell Pushing Data

AUTHORS: SAWYER and HURBAN
Aberdeen Proving Ground

ABSTRACT: Shell pushing experiments were performed on a 152mm, M81 (deep missile groove) gun launcher to provide axial and tangential strain data at eight positions along the exterior of the tube. In addition, an XM409E4 projectile was instrumented to provide tangential strain data in the fuze cavity. A 600,000 pound universal testing machine was used to push standard inert projectiles through the gun tube.

The finite element method of stress analysis was used to calculate the band pressures from strains recorded from the gun tube and also calculated from the strain recorded from the instrumented projectile. The calculated band pressure (from tube strains) varied from 21,000 psi at the muzzle to 57,000 psi at the origin of rifling. The band pressure calculated from the projectile strain differed by 15%.

◆

TITLE: Experiment to Assess Capabilities of an Automated Small Arms Test Facility

AUTHORS: PHILLIPS and JONES
US Army Infantry Board

ABSTRACT: The Infantry Weapons Test Methodology Study conducted by the United States Army Infantry Board resulted in the establishment of small arms measures of effectiveness and three instrumented small arms test facilities. This paper summarizes the analytical procedures in the MOE establishment, and an experiment conducted on the defense test facility.

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TITLE: A New Emphasis on the Use of Excited-State g Factors for the Interpretation of Impurity-Ion Spectra

AUTHORS: KULPA and KARAYIANIS
Harry Diamond Laboratories

ABSTRACT: Because of extensive theoretical and experimental difficulties, spectroscopic splitting factors have seen comparatively little usage as tools for interpreting the optical properties of laser materials. This report discusses methods for circumventing a number of these problems when dealing with solid state systems. Theoretical analysis is performed on impurity-ion, host-crystal interactions where the crystal-field levels are degenerate, Kramers-type doublets. It is shown that for states of the same group characterization within a given JLS multiplet, the trace of the Zeeman interaction is relatively insensitive to term and J mixing effects. Once evaluated in a basis |LSJM>, this sum's approximate invariance is demonstrated to serve as a simple diagnostic tool which effectively bypasses some theoretical difficulties associated with g-factor interpretations. Recent optical studies of Nd^{3+}:$CaWO_4$ and Er^{3+} $LiYF_4$ are discussed wherein excited-state g factors are shown to easily clarify a number of questionable identifications in the fluorescence spectra. To circumvent some of the limitations of optical Zeeman spectroscopy, a double resonance spectrometer has been designed and built for the extension of EPR techniques to excited states. Important aspects of this system are discussed together with efforts currently underway for study of the new laser host, $LiYF_4$.

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TITLE: Momentum Transfer from Explosion-Driven Shock Waves to Tree Stems

AUTHORS: KEOWN, NIKODEM and STOLL
US Army Engineer Waterways Experiment Station

ABSTRACT: A study was conducted to develop a simple, reliable method for predicting the munition size required to hastily construct a helicopter landing zone in vegetated terrain. This study resulted in a mathematical model, described herein, for predicting tree remnant height as a function of distance from an explosion center, weapon yield, and tree stem diameter and wood strength.

The response of a stem to dynamic loading resulting from a shock front is treated theoretically. The loading is assumed to consist of two components, a dynamic drag and a pressure difference. Stem motion is calculated by finite difference techniques, and the stem is assumed to break at the height above ground where a failure criterion is first satisfied. Scaling of the results for trees with different wood strength properites and diameters and for various weapon yields generalizes the solutions to the problem. Predicted tree remnant heights are compared with those measured in field tests. An experimental technique to measure the final velocity of stem segments (logs) thrown into free flight by blast forces is described, and experimental and predicted velocity data are compared for 13 logs. Application of the tree remnant height prediction model to evaluation of sites for helicopter landing zones is shown to be practical.

◆

TITLE: Receiver Design and Evaluation by Computer Simulation

AUTHOR: KLEIN
Fort Monmouth

ABSTRACT: This study was undertaken to determine the effectiveness of a comb filter detection system for use in battlefield sensor monitoring. Economic considerations for the sensor transmitter result in large frequency uncertainty, and this in turn increases the vulnerability of a limiter discriminator detector to co-channel interference. A comb filter, however, offers the possibility of eliminating this vulnerability. Preliminary analysis show that the critical aspect of such a detection system lies, not in the comb

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Nixon Selects Abrams As Army Chief of Staff

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Following a 1946-48 tour as Director of Tactics at the Armored School, he attended the Command and General Staff College. Graduated in 1949, he returned to Europe to command the 63d Tank Battalion, 1st Infantry Division and later, the 2d Armored Cavalry Regiment.

After a year in the United States as a student at the Army War College, GEN Abrams was assigned to Korea, serving successively as chief of staff of I Corps, X Corps and IX Corps. In 1955 he became chief of staff of the Armored Center at Fort Knox, Ky.

Promoted to brigadier general in 1956, he was assigned to the Department of the Army General Staff as the deputy assistant chief of staff, Reserve Components.

Returning to Europe in 1959 as assistant commander of the 3d Armored Division for a year, he was promoted to major general and named Deputy Chief of Staff, Operations, HQ United States Army, Europe.

In October 1960, he was again assigned to the 3d Armored Division as division commander, then he returned to Washington, D.C. in May 1962 for assignment as assistant DCS for Military Operations for Civil Affairs.

In July 1962 he was appointed director of operations in the Office of the Deputy Chief of Staff for Military Operations, and later assumed duties as assistant DCS for Military Operations for Requirements and Programs.

Lovelace Succeeds Timberlake As MERDC Engineering Deputy

Retirement of Turner G. Timberlake after 30 years of military-civilian service has resulted in Thomas W. Lovelace being selected to succeed him as associate deputy for engineering at the U.S. Army Mobility Equipment Research and Development Center.

Thomas W. Lovelace

Lovelace, 41, a MERDC employe since 1961 when he started as a project engineer, now is one of the center's highest ranking civilian employes, with responsibility for planning, directing and reviewing the technical content of the engineering program.

For the past four years he has been chief, Gas-Turbine/Advanced Power Sources Branch, Office of the Project Manager for Mobile Electric Power.

Graduated in 1954 from Virginia Polytechnic Institute with a BSME degree, he then served in the Army until 1956.

His work earned him a 1965 Quality Increase in Salary Award and in 1966 he was nominated by the Engineering Department for the commanding officer's annual Technology Award. He is a member of the Society of Automotive Engineers.

Templeman Moves to Dual Role As ECOM, Monmouth Deputy CG

BG James M. Templeman, formerly director of Procurement and Production, Army Electronics Command (ECOM), was elevated recently to deputy CG of ECOM and the Fort Monmouth installation.

BG James M. Templeman

BG Richard W. Swenson departed that dual responsibility for an assignment as CG, Strategic Communications Command, Europe, and Deputy Chief of Staff, Communications Electronics, U.S. Army Europe and 7th Army.

BG Templeman is serving his sixth tour at Fort Monmouth. He began his Army career in 1942 as an enlisted man and achieved officer status in 1944. Following World War II he served in the Far East Command and Germany. In 1967–68 he served in Vietnam as an adviser to the Vietnamese J-6 Joint General Staff and the Vietnamese Chief Signal Officer.

BG Templeman has a BS degree in electrical engineering, a BA degree in mathematics and a MS degree in physics, all from the University of Washington. He is a graduate of the Command and General Staff College, the Armed Forces Staff College and the National War College.

His military honors include the Legion of Merit (LM), Bronze Star Medal (BSM) and the Army Commendation Medal (ARCOM).

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filter parameters, but in the logic algorithms used to process the comb filter outputs.

This paper describes the use of computer simulation as a design aid, in determining appropriate logic algorithms, and also as a test vehicle to predict performance of the resulting system. The detection logic consists of four sections 1) comb filter, 2) adaptive threshold detector, 3) filter search and track algorithms, and 4) preamble and data detector.

The entire system was tested and optimized by processing simulated signals, with additive noise and various types of co-channel interference, by Monte Carlo methods. Significantly improved performance was measured, compared to similar laboratory tests performed on the limiter discriminator system. Improvement factors are included in the classified paper.

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TITLE: A Unified Method for Describing Vehicle Dynamics
AUTHORS: MURPHY and LESSEM
US Army Engineer Waterways Experiment Station

ABSTRACT: Description of the vibration experienced by a vehicle in its traversal of irregular terrain is a difficult problem because many factors are involved. These include the roughness and spectral content of the terrain, the nonlinear mechanics of the vehicle, and certain physiological responses of the occupants. A method for predicting vehicle vibration has been developed that considers the interaction of these factors in a straightforward way and presents the results in an easy-to-use graphic form. The method takes advantage of the fact that off-road terrain roughness can be classified into relatively few categories based on spectral content. Within each category, terrain roughness can be classified in terms of root mean square (RMS) elevations. Vehicle properties are characterized by field-validated mathematical models with special attention given to nonlinear structural elements. Human factors are included in terms of absorbed power and maximum acceptable acceleration. The method outputs a graph depicting, for a given vehicle and a given broad terrain type, response RMS accelerations and absorbed power as a function of terrain roughness and vehicle velocity. The graph is easily used in vehicle design studies and in analytical models of overall vehicle mobility.

◆

TITLE: Fabrication of Optical Elements by Means of a Low Energy ION Beam
AUTHOR: LESTER
Frankford Arsenal

ABSTRACT: Fabrication of high quality optical components such as lenses and mirrors by conventional methods of grinding and polishing is a demanding task performed by highly skilled artesians. This paper describes a new process which utilizes an intense beam of low energy positive ions to sputter surface atoms off optical materials under the direction of an on-line computer to form highly accurate optical elements. Basic to the utility of this process is the fact that the atomic erosion rate of a specific optical material can be experimentally determined as a function of the ion beam parameters with very high precision. An error matrix is computer generated for the surface of each optical element to be fabricated and the ion beam is deflected to each elemental surface area for the appropriate dwell time specified by the surface error matrix. The resultant optical surface is both highly accurate and extremely smooth. The low energy, linear, positive ion accelerator designed and utilized for optical fabrication is described together with experimental results of erosion rates, and surface microstructure morphology.

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TITLE: Mapping Seismic Response Characteristics of Complex Terrain
AUTHORS: LINK, MARCUSON
Waterways Experiment Station

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ABSTRACT: The Army's capability in battlefield and perimeter defense surveillance is being significantly improved by the use of electronic sensor systems. One of the more promising sensor types, the seismic intrusion detector, is activated by micro-seismic energy placed in the ground by an intruder. The performance of these devices has been shown to be very sensitive to the operational environment and, thus, their rational deployment and use require a knowledge of the effects of the environment on sensor performance.

Work conducted at the Waterways Experiment Station (WES) over the past 18 months has resulted in significant progress in the development of the technology and procedures for the production of intelligence products for seismic intrusion detectors. A theoretical model has been developed that predicts seismic signal characteristics with distance for any source and another model was developed for combining the predicted seismic signals with seismic intrusion detector characteristics to predict sensor performance. The WES approach for acquiring the inputs to these models, utilizing the models, and producing intelligence products from their outputs is discussed in conjunction with the status of the work being conducted.

TITLE: An Extended Finite Differences Method for the Solution of System Problems
AUTHOR: LONGCOR
West Point, New York

ABSTRACT: An extended variational formulation is developed for solving a wide range of system problems numerically. The numerical integration method, which acts as an ideal predictor for certain systems, derives directly from the fundamental laws of nature by means of an action functional.

The highly accurate numerical predictor is then enjoined with its action functional to provide a powerful problem solving combination. The action functional itself, a Lagrangian, is used to formulate a generalized Lagrangian recipe which by way of Euler's equation directly produces system-dynamic equations of motion.

TITLE: High C-W Laser
AUTHOR: LYMAN
Aberdeen Proving Ground

ABSTRACT: CLASSIFIED

TITLE: Optimization of Resource Allocation in Maintenance Management Logistics Systems
AUTHORS: TRENT, MARTIN and WINE
US Army Construction Engineering Research Laboratory

ABSTRACT: System availability and cost constraints imposed on tactical weapon systems necessitate corresponding care in the design and implementation of their associated maintenance management systems. It is necessary to forecast maintenance manpower staffing levels required to ensure consistent system performance within operational goals, and to perform comparative analyses of total program costs, including supportive resources.

Examples of the constraints and types of rules imposed on a resource allocation system designed for application to the SAFEGUARD BMD System will be described. Based upon these rules, a computerized management system has been designed which meets maintenance planning and operational requirements.

One of the objectives of this paper is to illustrate that corresponding sets of requirements and rules can be developed and entered into such a system to provide the maintenance control, efficiency assessments,

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personnel actions

COL Tate Assumes Command Of STRATCOM Signal Group

COL Lester K. Tate has assumed command of the U.S. Army Strategic Communications Command (STRATCOM) Signal Group-South, Panama Canal Zone.

COL Tate was the director of special scientific activities for STRATCOM's Safeguard Communications Agency at Fort Huachuca, Ariz., until selected to succeed COL Frank K. Gardner, now stationed in Turkey. COL Tate is serving also as assistant chief of staff, Communications-Electronics, U.S. Army Southern Command.

After earning a bachelor of science degree in electrical engineering from the University of Oklahoma, he entered the Army. He is a graduate from the Command and General Staff Course at the Naval War College and the Industrial College of the Armed Forces.

In Korea he commanded a signal company with the 2d Infantry Division, and in Vietnam was a signal battalion commander with STRATCOM-Pacific's 1st Signal Brigade. He also has served as chief, Pacific Networks Branch, Office of the Assistant Chief of Staff (Communications-Electronics), Department of the Army; contingency plans officer, HQ U.S. Army-Europe; deputy manager for Project Mallard; and deputy director, TRI-TAC, a joint service tactical communications system.

COL Lester K. Tate

Among his awards and decorations are the Legion of Merit with Oak Leaf Cluster, Army Commendation Medal with two Oak Leaf Clusters and the Bronze Star Medal.

RIA 36-Year Veteran Selected To Head WECOM Directorate

Designation of S. R. Wildman as head of the Arsenal Operations Directorate, HQ, U.S. Army Weapons Command (WECOM), Rock

Island, Ill., has been announced by COL Paul E. Martin, arsenal commander.

Wildman, whose career at RIA began in 1935, now has the responsibility for the planning, directing, and coordinating of all phases of manufacturing, assembling, and rebuilding or modification of major items and components of small arms, aircraft weapons, artillery and combat vehicle armament.

The directorate consists of approximately two million square feet of manufacturing and assembly area, 4,000 machines, and approximately 1,500 personnel.

Wildman earned a bachelor's degree in economics from Augustana College by 9½ years of evening school courses. Then he received an MS degree in business administration from Northern Illinois University in Dekalb, and did additional graduate work at the Universities of Illinois and Iowa.

During World War II, he enlisted in the Army Air Corps Aviation Cadet Program and served as an aerial navigator. After World War II, he returned to RIA and climbed the career ladder in progressively responsible positions. In 1962-63 he was deputy project manager for the Vulcan Air Defense System.

An assignment as deputy project manager for rifles was followed by promotion to chief of small business for the Army Weapons Command, until his present appointment.

S. R. Wildman

HumRRO Drivers Information Manual Is Instructional Objectives Guide

"Driver Education Task Analysis: Instructional Objectives," published recently, is the third hardback book published by the Human Resources Research Organization (HumRRO), one of the Army's major contract agencies.

Originally prepared for the Department of Transportation as Volume III of the DOT-DE (driver education) series of publications, the book sells for $10. In addition to instructions, the book contains a series of tests to measure the degree to which students have achieved training objectives.

Additional information may be obtained from: HumRRO, 300 N. Washington St., Alexandria, Va. 22314

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and cost reductions necessary in implementation of an Integrated Facilities System for major installations under the cognizance of CONARC, AMC and other Agencies. It is believed that this type of technology transfer illustrates the benefits achievable by application of the results of development activities on such specialized tactical systems.

TITLE: Bridge Response to Explosion-Produced Water Plumes
AUTHOR: MCANALLY
US Army Engineer Waterways Experiment Station

ABSTRACT: The water plume generated by an underwater explosion has been shown to be an effective bridge demolition tool. The objective of this study is to define the forces exerted on an overhead object by a water plume in order that protective schemes may be devised. A simplified model was developed to describe the loading that a variable-mass impact device experienced when it was subjected to the forces associated with a rising plume. This model yields a dimensionless relative density function that can be used to predict the plume loading on bridge superstructures that results from underwater explosions.

TITLE: Fabrication of New Composite Materials
AUTHOR: McCAULEY
Army Materials & Mechanics Research Center

ABSTRACT: The feasibility of fabricating lamellar, ceramic based composites with controllable and easily modified properties by reactive hot-pressing of gamma-Al_2O_3 with Ba-mica ($BaMg_3Al_2Si_2O_{10}F_2$) has been successfully demonstrated. Cylindrical disks 2 inches in diameter by 1/4-inch thick of Ba-mica/Al_2O_3 composite material with greater than 99.5% of theoretical density have been produced with the following range of properties: Knoop$_{100}$ hardness from 950 to 1970 kg/mm^2, four-point flexure strength from 38,000 to 53,500 psi, and Young's Modulus from 28.6 to 60.5 x 10^6psi.

Reactive hot pressing of K-mica ($KMg_3AlSi_3O_{10}F_2$) with gamma-Al_2O_3 showed that fully dense K-mica/Al_2O_3 composites cannot be fabricated by processing at pressures up to 7000 psi. The process does, however, allow for the fabrication of eutectic-like $MgAl_2O_4/Al_2O_3$ composites 700 C below the eutectic temperature.

TITLE: Laser Assisted Low Energy X-Ray Flash Generation
AUTHORS: SHATAS, ROBERTS, MEYER, and STETTLER
Redstone Arsenal

ABSTRACT: The Langmuir frequency of the dense plasma focus matches closely the CO_2 laser frequency; consequently, a strong absorption is expected within the volume of contained plasma. For thermonuclear radiation effects studies, laser assisted plasma focus can be employed for fusion neutron or soft x-ray pulse generation. In the latter case, high-Z material is laser injected into the nascent focus, and plasma cooling by enhanced x-ray radiation is compensated by laser heating. Numerican calculations for ff, fb, bb, and total radiation for 5% Cu or Fe injection into focus to enhance the x-ray yield are presented for electron temperatures from 0.5 to 10 keV. Laser to x-ray energy conversion efficiencies near 50% are feasible. At electron temperatures in excess of several keV, the critical electron density must be maintained and the anomalous absorption invoked to obtain the laser energy absorption in a single pass through focus. Estimates for the threshold of the anomalous absorption are presented. Most of the calculations were performed in the context of the boiler model for the dense focus, although estimates for the x-ray yield are relatively model independent. The required laser energies of 10^2 to 10^3 J per 10^{-7} sec pulse are obtainable from electron-beam preionized CO^2 laser devices.

TITLE: Lightweight, Small Laser Transmitter Design for Rangefinder
AUTHORS: STROZYK, MOSS and HYND

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Fort Monmouth
US Military Academy

ABSTRACT: Since 1962 research in the area of "Q" switched laser devices for rangefinder application has advanced continuously. The results of this research have been incorporated in several military rangefinders and/or target designators for special purpose uses. Unfortunately, these units have in general been heavy and bulky devices. With the development of Nd:YAG, a low threshold laser material, attention has been directed toward the technology necessary for fielding smaller, lightweight, less costly rangefinders. This paper describes the original in-house development of suitable "Q" switched laser transmitters for use in very lightweight rangefinders. Indeed, the design concepts have been utilized in the feasibility studies of the "hand held laser rangefinder (AN/GVS-5)". The discussion reviews the design philosophy, reduction to practice and test results of the laser oscillator.

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TITLE: Fracture Mechanics Applicability to Portland Cement Concretes
AUTHOR: NAUS
US Army Construction Engineering Research Laboratory

ABSTRACT: In this investigation, the applicability of linear-elastic fracture mechanics to portland cement pastes, mortars, and concretes was determined by the fabrication, testing, and analysis of plate specimens containing a precast flaw. The results indicate that: the concepts of linear-elastic fracture mechanics were not directly applicable to concrete materials for the specimen geometry chosen and thus the applicability of fracture mechanics to concrete materials for other specimen geometries and loadings seems questionable; other analytical techniques such as net section stress do not appear applicable as a failure criterion; and, specimens to which strain gages were attached indicate that large localized strains occur in mortars and concretes. A model was developed which provides a qualitative measure of the size of the microcracking zone which occurs in concrete. Experimental results are correlated with the model.

◆

TITLE: The METRRA Technique
AUTHOR: ORIGLIO
US Army Mobility Equipment R&D Center

ABSTRACT: The technology of nonlinear detection systems currently known as METRRA are described. The research studies, and investigations surrounding the nonlinear junction phenomena, experimental system development and field test results are presented.

The impact on the reconnaissance and surveillance capability of the field Army by METRRA technology will be discussed in the light of the modern Army need.

◆

TITLE: A Mediator for Triggering Non-Specific Host Defense Mechanisms
AUTHORS: PEKAREK and WANNEMACHER
US Army Medical Research Institute of Infectious Diseases

ABSTRACT: Prospective clinical studies in volunteers at this Institute have demonstrated the onset of significant anabolism-related metabolic processes early in the prodromal period and before the onset of overt clinical illness of experimentally-induced bacterial or viral infections. We have shown in experimental animals and man that the mechanisms leading to these early host changes are triggered by an endogenous humoral factor which is released, in part, by polymorphonuclear leukocytes and enters the circulation after the initiation of a generalized infection. Upon administration to normal recipient animals, endogenous mediator obtained from PMN leukocytes triggers a significant flux of free amino acids and certain trace metals to the liver, which, in turn, is followed by hepatic output into the serum of the α_1 and α_2 acute phase

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personnel actions

Smith Becomes Deputy CG Of Computer Systems Command

Deputy CG of the U.S. Army Computer Systems Command became a full-time duty for the first time when COL (BG designate) Paul T. Smith, formerly the deputy for Tactical Systems, was recently assigned to that position.

COL Smith served as adjutant general, HQ U.S. Army Vietnam, until last August. His career includes unit and staff assignments in Japan, Korea and Germany as well as in the United States.

A veteran of 28 years of military service, he earned BS and MS degrees from the University of Maryland under the Army advanced education program. He also has graduated from the Army War College, and the Command and General Staff College.

Among his military honors are the Legion of Merit with two OLCs, the Bronze Star, and Army Commendation Medal with two OLCs.

Grombacher Assumes Command Of Communications Agency

COL Gerd S. Grombacher, a brigadier general nominee, is the new commander of the U.S. Army Safeguard Communications Agency (USASCA), Fort Huachuca, Ariz. Until recently he was the executive in the Office of the Assistant Chief of Staff (Communications-Electronics), Department of the Army, following an assignment as commander, Signal Service Group 4, STRATCOM, Europe.

COL Gerd S. Grombacher

COL Grombacher succeeds BG I. R. Obenchain Jr., who retired Apr. 1. Since his departure, BG George M. Snead Jr., deputy CG, Strategic Communications Command

(STRATCOM), has also served as acting CG of the USASCA.

Graduated from the University of Maryland with a BS degree, COL Grombacher holds a master's degree from George Washington University. He remained as an instructor after graduating from the Command and General Staff College, and the Armed Forces Staff College.

Completing studies at the Air War College in 1967, COL Grombacher was named chief of the Operations Division, Office of the Assistant Chief of Staff (Communications-Electronics), U.S. Army, Vietnam.

He entered the Army in 1943 as an enlisted man, rising to the rank of master sergeant in the Intelligence field. Discharged in 1945, he was given a field commission as second lieutenant. He joined the Active Reserve in 1946 and returned to active duty in 1950 with the 519th Military Intelligence Platoon, Fort Riley, Kans.

In 1968 he served as signal officer for the Twenty-Fourth U.S. Army Corps-Vietnam. Upon his return to the U.S., he was named director of specialist training at the Army Signal School, Fort Monmouth, N.J.

Among his awards and decorations, he holds the Silver Star, Legion of Merit with one Oak Leaf Cluster, Bronze Star Medal, Meritorious Service Medal, Army Commendation Medal with two Oak Leaf Clusters, and Purple Heart.

Ballard Gets PL-313 STRATCOM Position

HQ U.S. Army Strategic Communications Command has its first PL 313 position, allocated recently, filled by Dr. Geoffrey E. H. Ballard, director of the recently organized Advanced Concepts Office, Fort Huachuca, Ariz.

Dr. Geoffrey E. H. Ballard

Dr. Ballard is the principal consultant and adviser to the CG of STRATCOM on emerging concepts in science and technology, advanced engineering, and command relationships. His office conducts studies in a broad scope of communications-electronics subjects, and makes recommendations on using innovative engineering approaches.

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globulins, Cu and additional ceruloplasmin. Thus, this endogenous mediator may be a key factor in the stimulation of early non-specific host defense mechanisms, and its appearance in the serum may be one of the earliest detectable host responses to infection.

◆

TITLE: Measurement of the Angular Distribution of Photoelectrons from Third Generation Photocathode Materials
AUTHOR: POLLARD
Night Vision Laboratory

ABSTRACT: The angular distribution of photoemitted electrons from p-type GaAs (Zn-doped)(110), (100), (111)B surfaces, activated with cesium and oxygen, was observed in a conventional LEED system using standard post acceleration techniques. The phosphor display of photoemission from activated specimens, illuminated with a small light spot, was measured with a spot photometer. The photoelectron distribution was found to be Gaussian, in angle, about the surface normal with a cone semiangle at half maximum intensity varying from $\sim$5° at 850 mμ to $\sim$9° at 350 mμ. This highly directional emission contrasts with the Lambertian distribution for conventional photocathodes; the difference is explained by the emission of a thermalized electron distribution, of small effective mass in the solid, under the conditions of effective negative electron affinity. A mathematical model, assuming transport through the accelerating band bending region and escape from the surface conserves momentum parallel to the surface, is given to explain the observations. It is predicted that all III-V semiconductors, activated to negative electron affinity, will exhibit highly directional photoemission. The impact of the measurements for wafer tube technology resulting in high resolution capability is briefly discussed.

◆

TITLE: The Effect of Burial on Fragmentation Munition Effectiveness
AUTHOR: RECHES
Aberdeen Proving Ground

ABSTRACT: Lethality calculations for fragmentation type munitions are generally based on above-ground burst heights. To date, no published methodology is available to determine the effect of partial burial on the lethality of a fragmentation munition.

To determine the effect of partial burial on the fragment spray envelope, it is necessary to know the exact source and emission angle of each fragment spray emanating from the munition. In current lethality calculations, all fragment sprays are assumed to emanate from the munition center-of-mass. In this paper, the Gibson-Wall theory, which predicts the source and angle of emission of each fragment spray as a function of munition parameters, is utilized to develop a method for determining the effect of burial on the munition's lethality. This method is used to determine the effect of burial on the lethality of the 105mm, M1, HE projectile.

We show that the fragment spray emission angles obtained with the Gibson-Wall theory agree closely with those obtained experimentally and with the Hydrodynamic Code.

We also investigate the effect of test arena size on the derived fragmentation characteristics of the munition.

◆

TITLE: Doppler Translator
AUTHOR: RITTENBACH
Fort Monmouth

ABSTRACT: An outstanding problem of MTI radar is that low speed targets of interest often have doppler shifts too low for satisfactory presentation to the ear. Automatic detection has been employed, but even the most elaborate schemes used today are no match for the excellent recognition capability of the human ear-brain combination.

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This paper describes theoretical and experimental investigations of a multitude of approaches to generate better audible signals from these low doppler signals. Doppler processing by time compression has by far the best target detection capability for poor signal-to-noise and signal-to-moving-clutter ratios. Other unique features of this scheme include: Use of the gaps produced by time compression for repetitive presentation to get a "second look" at questionable signals; Presentation of multiple doppler signals (e.g., from several range gates) without degrading the signal-to-noise ratio; Signal storage applicable to automatic detection schemes for recall and examination at the operator's convenience.

Instrumentation and tests are discussed. This technique has application to radar, sonar, seismic, biomedical and mechanical data.

◆

TITLE: Spectroscopic Studies of Luminescence Emitted by Dyes Irradiated by Laser Light
AUTHORS: SOUSA and ROACH
US Army Natick Laboratories

ABSTRACT: The physical principle involved in photo-induced radiative and radiationless processes in polyatomic molecules are necessary in order to understand more fully the luminescence usually accompanying such phenomena. By applying techniques of laser photolysis and spectroscopy developed in this laboratory, we have been able to gain some insight into these principles. Particularly, we are able to determine detailed time resolved measurements of rapidly decaying transients in photo-chemical processes, i.e., using a method of convolution integrals we are able to accurately measure fluorescent decay times in the nanosecond region. We are using information gained from these studies to seek out a solution to the problem of induced luminescence generated in dyes, such as those found in military clothing and in pigmented paints, when irradiated by multiple wavelength lasers. Such luminescence emits wavelengths different from the laser, which may present a possible degrading element to camouflaged systems. Several materials of Army interest have already been investigated and their luminescent properties measured and recorded.

◆

TITLE: A Probabilistic Model for Structuring a Drainage Network
AUTHORS: ROBINSON, and SWARTZ
Fort Hood

ABSTRACT: The structure of a naturally occurring drainage network is described in terms of four network parameters. The parameters are basin shape, bifurcation ratio, stream length ratio, and a coefficient affiliated with drainage density. The parametric relationships are inferred from previous theoretical and empirical work in the field of quantitative geomorphology and from considerations of the most probable state. Equations are developed that describe the parametric relationships and solutions are indicated for various parameter values. The mathematical structure is then used as a basis for a stochastic model that predicts the number, sizes and interfluvial distances of streams expected to be crossed in traversing a drainage basin with a force of varying width. Finally, the model is applied to assist in estimating the amount of stream-crossing equipment required for a military force to cross a large land mass. Two examples of the application are included. The military planning examples are only illustrative, however, and not intended to imply a restricted application of either the model or its underlying theory.

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TITLE: Electrical Simulation of the Internal Electromagnetic Pulse
AUTHOR: ROSADO
Harry Diamond Laboratories

ABSTRACT: Practical limitations in adequately simulating the radiation from a nuclear weapon, both in underground and laboratory tests,

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personnel actions

Ballard Gets PL-313 STRATCOM Position

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He first worked for the government in 1963 when he joined the U.S. Army Materiel Command's Cold Regions Research and Engineering Laboratory at Hanover, N.H. Following an assignment as physical sciences administrator with the Army Materiel Command in Washington, and with the Army Electronics Command as the director of the Institute for Exploratory Research, he transferred to HQ STRATCOM in November 1970.

He has controlled theoretical and experimental research in the physical sciences, including physics, electronics, mathematics, and communications and propagation research.

Dr. Ballard has a BS degree in engineering from Queens University, Kingston, Ontario, and a PhD from Washington University.

Eighteen of his technical papers have been published in scientific journals in England, Switzerland, Canada and the United States. He was a graduate assistant and Wheeler Fellow while at Washington University and visiting professor at Dartmouth College in 1965.

Dr. Ballard was selected to attend the UCLA-ARPA Defense Science Seminar in 1966 and later became chairman of the Defense Science Seminar Alumni Planning Group. He has participated on many panels such as the Department of Defense-National Academy of Science summer studies, and was recently selected to attend the Harvard Graduate School of Business Advanced Management Program.

MATCOM CG Earns Promotion To 2-Star Rank in Germany

MG Harold B. Gibson Jr., deputy CG of wholesale support for the Tactical Systems Command and CG of the U.S. Army Materiel Command, Europe, (MATCOM) was recently promoted to 2-star rank at Zweibruecken, Germany.

MG Gibson, a 29-year Army veteran, assumed command of MATCOM in August 1971, after serving as director, Plans, Office of Deputy Chief of Staff for Logistics, Washington, D.C.

He has a bachelor's degree in military science from the University of Maryland and a master's degree in business administration from Syracuse University. He is a graduate from the U.S. Army Command and General Staff College and the Industrial College of the Armed Forces.

Among his military honors are the Distinguished Service Medal, Legion of Merit, Bronze Star, Meritorious Service Medal, Joint Service Commendation Medal, two Army Commendation Medals, the Purple Heart, and the Vietnamese Distinguished Service Order and Army Honor Medal.

6 OCRD Assignees Show Similar Qualifications

Six officers who reported recently for new assignments with the Office of the Chief of Research and Development, Department of the Army, are veterans of service in Vietnam or Korea and have master's degrees in engineering or science.

LTC James E. Drummond is a staff officer with the Command, Control and Communications Branch, Command Systems Division.

In 1971-72 he was assistant chief of staff, G-1, 2d Armored Division, Fort Hood, Tex., and from 1969-71 was commander, 1st Battalion, 3d Field Artillery, 2d Armored Division, Fort Hood, Tex. In 1966-67 he served as subsector adviser, Republic of Vietnam.

From 1962-65 LTC Drummond was assistant professor, Department of Earth, Space and Graphic Sciences, United States Military Academy (USMA), West Point, N.Y. He also served in 1959-60 as administrative assistant to the chief of staff, Second Army, Fort Meade, Md.

LTC Drummond received a 1955 BS degree from the USMA and in 1962 was graduated with an MS degree in aerospace engineering from the University of Arizona. He has also attended the Army Command and General Staff College.

Among his military honors are the Legion of Merit (LM), Bronze Star Medal (BSM), Air Medal (AM) and the Army Commendation Medal (ARCOM).

LTC Eugene Fox is a staff officer with the Missiles and Special Weapons Division. In 1971-72 he commanded the 5th Battalion, 59th Air Defense Artillery, assigned to the 11th Air Defense Artillery Group, Fort Bliss, Tex. He was division chief, Safeguard Control Training Facility, Fort Bliss, Tex. (1968-70) and an adviser (1966-67) with the Military Assistance Command, Vietnam (MACV). During 1963-64 he was a battery commander with the Army Training Center, Fort Sill, Okla. and served with an S-4 squadron in Bamberg, Germany (1960-63).

LTC Fox received a BS degree from the USMA in 1956 and an MS degree in aerospace engineering from the University of Arizona in 1966. He graduated in 1968 from the Army Command and General Staff College.

His military honors include the LM, BSM, AM and the ARCOM.

LTC Hal F. Stolz is a staff officer with the Life Sciences Division after serving as chief, Medical Effects Division, Medical Directorate, Defense Nuclear Agency.

He was an instructor with the Subsistence and Food Technology Directorate, U.S. Army Quartermaster School, Fort Lee, Va., in 1964-67 and post veterinarian at Fort Gordon, Ga., in 1963-64. In 1961-62 he served with the 106th Medical Detachment in Korea.

LTC Stolz graduated from the Army Command and General Staff College this year and holds a 1958 PhD degree in veterinary medicine from the University of Georgia. In 1968 he was awarded an MS degree in radiation biology at the University of Rochester, N.Y. He has been awarded the Meritorious

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stimulated the search for other means of assessing the vulnerability of a system to the internal electromagnetic pulse (IEMP). This paper presents a procedure for evaluating the effects of the IEMP on an electronic system. The theory and application of electrical simulation which forms the basis of this new method, is described in detail. Excellent agreement between underground test results and predictions based on this procedure have been obtained for different system models.

TITLE: "Near Optimal Takeoff Performance of a Heavily Loaded Helicopter in Ground Effect"
AUTHORS: VAUSE and SCHMITZ
US Army Air Mobility R&D Laboratory

ABSTRACT: A mathematical dynamic performance model of a heavily loaded single rotor helicopter operating in ground effect has been developed. Good agreement between test and theory is shown in hover and forward flight. The mathematical performance model is then used to determine optimal and near optimal takeoff performance under heavily loaded conditions. Although some takeoff performance is sacrificed, ease of implemenation under operational conditions favors the use of near optimal takeoff flight profiles. When these profiles are compared with similar flight test results taken on the UH-1B helicopter, good agreement between test and theory is noted. Near optimal takeoff performance is shown to be sensitive to acceleration height, excess power in hover, wind, rotation velocity and piloting technique. Operational implications of these results are discussed and a simple control policy is suggested to minimize the sensitivity of takeoff distance to possible pilot error.

TITLE: Effect of Ingot Thermal Mechanical Processing Treatments on the Grain Size and Properties of Wrought 7075 Alloy
AUTHORS: WALDMAN and SULINSKI
Frankford Arsenal

ABSTRACT: An investigation was carried out on the effect of various ingot thermal mechanical processing treatments on the grain size and mechanical properties of homogeneous 7075-T6 aluminum alloy sheet. The results indicate that the distribution of the major alloying elements (Zn, Mg, Cu) is as important as that of the anti-recrystallization alloying addition (Cr) in controlling the recrystallization behavior of worked ingots of 7075. Data are presented which show that fine-grained wrought 7075-T6 sheet, produced by special ingot processing techniques, has equivalent strength and better ductility characteristics than conventionally processed material.

TITLE: Choosing Performance Parameters for a Ground Surveillance Radar with Foliage Penetration Capability
AUTHOR: SURGENT
Aberdeen Proving Ground

ABSTRACT: In examining the development of ground surveillance radar systems for the past 20 years, it is pertinent to note that those systems have been most affected by the growth of technology. The push for greater ranges and higher resolutions coupled with the evaluation of new components at higher frequencies have dictated the path that radar development was to take.

From the beginning of the ORCRIST project in 1964, we have attempted to apply different criteria to the selection of radar parameters. The general practice in radar technology has been to utilize as high a frequency as possible with available power sources in an attempt to optimize the systems by emphasizing its resolution capabilities. However, our experience has shown that quite a few important considerations, which are particularly relevant under intense clutter conditions, may indicate strong preference towards the lower frequencies. This paper will attempt to describe these considerations and how they have resulted in the development of LWL family of foliage penetration ground surveillance radar systems. A ground surveillance radar for

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these purposes is defined as a radar that performs surveillance on the ground from either the ground or from an elevated platform.

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TITLE: Penetration of the Intestinal Epithelium by Various Microorganisms
AUTHOR: TAKEUCHI
Walter Reed Army Institute of Research

ABSTRACT: In most enteric infections, penetration of the gut epithelium by pathogenic microbes is the first step in establishing lesions in the host. Yet this first step had long been neglected. Utilizing histology, fluorescent antibody staining technique, histochemistry and electron microscopy, my study over the years has focused on the mechanism of this first step and on the host-microbe interaction in the gut mucosa.

Enteric pathogens may be classified into four groups in accordance with their invasive potential into the host. The first group is characterized by a pathogen which invades through the epithelial barrier, multiplies in the mucosa and leads to a systemic invasion. Salmonella belongs to this group. The second group is represented by shigella which produces far more severe epithelial changes than salmonellae. Shigellas tend to reside and multiply in the epithelial cells. Members of the third group preferentially reside at the surface of the gut epithelium and may or may not produce an acute inflammatory response and structural alterations of the gut mucosa. This group includes intestinal parasites --Cryptosporidia, Giardia and enteric spirochetes. The last of the four groups neither penetrates nor physically attaches to the gut epithelium but causes severe symptoms through absorption of their products of growth and is exemplified by cholera vibrio.

◆

TITLE: Data Processing System Analysis
AUTHOR: VICK
US Army Advanced Ballistic Missile Defense Agency

ABSTRACT: The design, development and test of real time software for implementation in a ballistic missile defense data processing system is one of the most challenging undertakings that computer scientists have had to come to grips with. Just as the hardware architects responsible for the super-computers of today, which employ gate counts in the millions, have evolved rigid disciplines and employed high degrees of automation to successfully deploy their product, the software architects of the super computers are establishing a "software engineering technology." This paper describes a program with the objective to identify and implement the beginnings of such a technology. Its major goal was to pioneer techniques which would make manageable and offer visibility and confidence in massive real time software systems such as those required in ballistic missile defense. The test described were conducted on five of the country's most capable supercomputers connected via a data link to a sixth computer on which simulation driver software was implemented. Some detail is given to the nature and characteristics of the simulation software.

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TITLE: The Mechanism of Action and Treatment of Palytoxin Poisoning
AUTHORS: VICK and WILES
Edgewood Arsenal

ABSTRACT: Palytoxin is one of the most potent coronary vasoconstrictors known, producing death within minutes by diminishing the supply of oxygen to the myocardium. Tests in animals with a number of vasodilators showed that papverine is an effective antitdote, but has to be injected directly into the ventricle of the heart because of the speed of action of the toxin. Sublethal doses of this toxin given intragastrically and intravenously produce elevated plasma cortisol levels and protect against subsequent lethal intravenous doses. A second sublethal injection of palytoxin after circulating plasma cortisol has decreased increases blood steroid levels and reestablishes

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6 OCRD Assignees Show Similar Qualifications

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Service Medal (MSM) and the ARCOM.

MAJ Robert H. Ammerman Jr., is a staff officer with the Command Systems Division. He served as an instructor and assistant professor, Department of Electrical Engineering, USMA (1968–71) and as chief, Networks Branch, Army Regional Communications Group, Vietnam (1967–68). He has also been executive officer with the Special Forces "A" Team in Laos, Vietnam and Okinawa.

MAJ Ammerman received a 1960 BS degree from the USMA and an MS degree in electrical engineering from Georgia Tech in 1967. He has graduated from the Army Command and General Staff College and the Army Signal School. His publications include the second edition (revised) of the *Integrated Wide Band Communications System.*

He has been awarded the BSM with Oak Leaf Cluster (OLC), ARCOM and the Purple Heart.

MAJ Robert J. Bohls, a staff officer with the Missiles and Special Weapons Division, recently completed a tour of duty with the U.S. Army Combat Developments Command Air Defense Agency, Fort Bliss, Tex.

He was operations research analyst, Office Intelligence Operations Research, MACV, in 1969 and S-4, 2d Battalion, 9th Artillery, 4th Infantry Division in 1968. During 1964–65 he was assistant operations officer, Command Post, 38th Artillery Brigade, Korea.

MAJ Bohls received a BS degree in mathematics from the University of Toledo in 1962 and an MS degree in operations research in 1968 from the Naval Post Graduate School.

He holds the MSM, Joint Service Commendation Medal (JSCM) and the BSM.

MAJ Samuel N. Liberatore is a new staff officer with the Air Defense Team, Missiles and Special Weapons Division. During 1968–69 he served with the G-3, IV Corps Advisory Group, MACV, following a 3-year tour as a personnel staff officer with the Deputy Chief of Staff for Personnel (DCSPER).

In 1959 MAJ Liberatore received a BS degree in mathematics from Loyola College and in 1972 an MS degree in guided missile engineering from the University of Texas. He has attended the Army Command and General Staff College and the officer guided missile systems course.

His military honors include the BSM, ARCOM with OLC and the Air Force Commendation Medal.

NATO Agreement Wins Thulin $1,500

A Special Act of Service Award of $1,500 was earned recently by Carleton L. Thulin for his work as a general physical scientist with the Advanced Materiel Concepts Agency, U.S. Army Materiel Command.

Thulin was instrumental in conceiving and originating an international effort which produced the NATO Standardization Agreement on Explosive Ordnance Disposal and Reconnaissance.

This agreement has been ratified for implementation by the Armed Services of 11 nations. It provides a framework for inter-operable Explosive Ordnance Disposal capabilities and doctrine for support of combat operations and civil defense.

People In Perspective

Persistence Over 34 Years Achieves University Degree

Determination persistent for 34 years has achieved Jack Gallagher's goal of a bachelor of arts degree from Fordham University in New York City. Gallagher, 52, is a supervisor in the Product Assurance Directorate, Picatinny Arsenal, Dover, N.J.

His educational interruptions began in 1938 after he graduated from high school. Marriage, a family, a reduction-in-force (RIF) that cost him his job, work in private industry, two years in the Marine Corps, some time in North Korea—all combined to delay his academic pursuits.

In 1946 he enrolled at Rutgers University for evening courses. This was fine for a while; then came a long interruption. Seventeen years later he was at it again, this time as a student at New York University from 1964 to 1968. He graduated with an associate-in-arts degree in liberal studies.

Gallagher started his career as a junior messenger at Picatinny Arsenal in 1939, working for $600 a year. He moved up to shop boy, shop inspector, and then transferred to the New York Procurement District. When he returned to Picatinny, he became a machine tool inspector, then ammunition materiel inspector lead foreman, and a supervisor.

He is now a branch chief in the Key Inspection Division of the Product Assurance Directorate.

Jack Gallagher

CDC Engineer Takes Top Award For Technical Paper Presentation

"Analysis of Partials (A Needed Methodology)" was selected as the best of eight technical papers presented at the recent American Ordnance Association symposium at the U.S. Army Weapons Command, Rock Island Arsenal, Ill.

The paper was authored and presented by John Martin, a mechanical engineer since 1969 with the Materiel Division of the U.S. Army Combat Developments Command Maintenance Agency, Aberdeen (Md.) Proving Ground (APG).

From 1962–65 he worked as a civilian employe in the capacity of armor test engineer with the APG Materiel Testing Directorate (formerly Development and Proof Services).

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protection. Pretreatment with hydrocortisone also protects against lethal doses of toxin. The 1 hour required for protection to develop is probably the time required for desensitization of the endothelial wall to vasoconstrictors. Adrenalectomized animals do not develop any degree of protection, substantiating the involvement of steriods. Repeated sublethal doses do not maintain the same high level of blood steriods, yet protection remains almost maximal, suggesting an immune mechanism.

These studies have provided a foundation for the development of a therapeutic regime for palytoxin poisoning with possible application to man.

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TITLE: A Unique Heterogeneous Explosion at Liquid Nitrogen Temperature, 77°K

AUTHOR: WELLMAN
Aberdeen Proving Ground

ABSTRACT: This report demonstrates that Raney nickel, a useful hydrogenation catalyst, initiates a violent explosion with tetrafluorohydrazine, N_2F_4, at liquid nitrogen temperature, 77°K. By partially deactivating the Raney nickel, the explosive reaction with N_2F_4 was sufficiently reduced to permit reaction product analysis.

The discovery of the violent explosive reaction between Raney nickel and N_2F_4 at 77°K could be of military value in situations where it is necessary to ignite a propellant or initiate an explosion at a very low temperature.

Supplemental Papers

TITLE: "Frontal Pressure"; As A Second Arming Environment For Fuzes Launched From Smooth Bore Barrels

AUTHOR: ANDREJKOVICS
Frankford Arsenal

ABSTRACT: Theoretical studies and empirical investigations are presented that prove that the transient pressure pulse ("frontal pressure") generated around a projectile by the compression of the air column in the gun tube does exist. The use of this environment may solve the perplexing problem of satisfying MIL-STD-1316A for non-spin gun-launched ammunition.

Frontal pressure is analyzed and described. A computer program determined the physical characteristics of the frontal pressure expansion wave. Ballistic tests confirm the theory and substantiate the computer program.

A computer program which determines the orificing of frontal pressure gases into a fuze is presented. Test results of prototype 20mm fuzes which use frontal pressure to do useful work are given.

◆

TITLE: Accurate Ephemeris Time Determination and Geocentric Stations Position From Photographs of the Moon Against Stellar Background

AUTHOR: BALDINI
US Army Engineer Topographic Laboratories

ABSTRACT: Up to now there is no method that can provide accurate determination of Ephemeris Time. The Improved Lunar Ephemeris gives the geocentric right ascension, declination, and the parallax of the moon, as functions of Ephemeris Time and not Universal Time, which is to record observations. Universal Time, UT2, is related to Ephemeris Time, ET, as follows

$$\Delta t = ET - UT2$$

Δt is a slowly varying quantity. At least six years of observations, are required to determine a good value for it.

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Supplemental Papers

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A theory has been developed which allows for the accurate determination of the value of Δt with only one day of observation. The geocentric station position can also be determined.

TITLE: Image Area Measurement Using A Sensor Array System
AUTHORS: CHEN and SEEMULLER
US Army Engineer Topographic Laboratories

ABSTRACT: An optoelectronic system for measuring object-image area is described. The system employs a light sensitive square array at the front end. Two dimensional image perturbation is introduced to improve measurement accuracy.

Area measurement error using sinusoidal, triangular and random image perturbation is analyzed and computed. The theoretical results indicate that sinusoidal image perturbation yields nearly a ten fold improvement in measurement accuracy, while random perturbation appears to be the most practical and results in negligible error. Triangular perturbation is optimum and theoretically yields zero measurement error.

Experimental results on a hardware model are presented. The system is capable of measuring dimensional properties of object-images projected on the array with good accuracy. Possible applications of the system in the fields of metrology and photogrammetry are discussed.

TITLE: A Three-Frequency Heterodyne Detection Laser Communications System for Army Tactical Applications.
AUTHORS: DWORKIN and ZAVIN
Fort Monmouth

ABSTRACT: Recent major advances in device technology have made practical the synthesis of laser communications systems at 10.6 micrometers for tactical applications. These advances have been in CO_2 laser design, modulation materials and techniques, and high sensitivity detectors operating at easily attainable cryogenic temperatures. Conventional systems utilizing intracavity FM modulation and heterodyne detection require very complex electronics, large package size, high power consumption, and high system cost. In addition, the receiver aperture is limited by atmospheric turbulence. A most promising alternate approach which reduces the problems of conventional systems is discussed in this paper. The three frequency heterodyne detection laser communications system is unique in that an externally mounted modulator simultaneously provides an FM modulated beam and an unmodulated beam, and uses optical mixing of these two beams with a local oscillator beam to produce a signal which electronically eliminates the effects of local oscillator instabilities. The system is developed in a detailed analytical study. Also contained is a brief discussion of the experimental phase now underway.

TITLE: Radar Arrays with No Phase Shifters
AUTHOR: HARTMAN
Redstone Arsenal

ABSTRACT: An alternate approach to problem of radar for field defense against low altitude high speed aircraft has been experimentally investigated. The concept is to phase detect the radar return signal at many elements of an antenna array and perform the necessary mathematical computation to determine the location of the target from the phase information. We have demonstrated that an optical computer correctly performs this computation. The advantage of this approach is the elimination of the costly phase shifters in a conventional phased array antenna. This paper demonstrates the detection of many simultaneous targets and discusses problems not associated with single target radar systems. Our conclusion is that this technique holds great promise, but needs further research.

TITLE: Formation and Reactions of Azide Radicals

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people in perspective

AVSCOM Employe Amasses Half Century Public Service

Nineteen days short of 50 years is the record of military and Federal civilian service set by Edward Koziboski when he retired recently at the U.S. Army Aviation Systems Command (AVSCOM), St. Louis, Mo.

A brief 3-year "retirement" in 1954 following 35 years of military service prevented him from reaching the half-century mark. A supervisory equipment specialist at AVSCOM when he retired, Koziboski has been involved in some aspect of aircraft engineering since he joined the fledgling Army Air Corps in June 1919.

Talking about his early experiences, he said: "I saw a lot of planes come and go . . . everything from the Curtis Jenny to the C-130." His reminiscences also focused on balloons, which he said "had no future, but were good training for engineers."

As a flight engineer with the 9th Air Ship Company at Scott Air Force Base, Ill., at one time, Koziboski flew in "gas bags with a gondola slung underneath . . . not the dirigible-type craft such as the Goodyear blimp."

His service spanned the change-over from the Army Air Corps to the U.S. Air Force. The aircraft he remembers are not all well-known—such as the B-10 which "could cruise at 180 mph" or the P-12, "a fighter plane that came into the system around 1935."

His Air Force career took him to the Philippines, Korea, Panama, and Guatemala, in addition to Illinois, California, Texas, South Carolina, Virginia, Missouri and Indiana.

When asked about cutting his service just short of 50 years, he replied philosophically, "I could be helping someone by getting out now . . . getting a 50-year pin is not as important as somebody's job."

AVSCOM Commanding General (MG) Fred Kornet Jr. congratulates Edward Koziboski on retirement after 50 years combined military-civilian service.

Bulletin Board . . .

Saintsing Reviews Progress On HELBAT, Other Activities

Assistant Secretary of the Army for Financial Management Richard L. Saintsing has reviewed the Human Engineering Laboratories Battalion Artillery Test (HELBAT).

The HELBAT project, which has been undergoing studies for three years, involves HEL studies in an effort to improve the techniques for delivery of field artillery rounds.

Saintsing visited Fort Hood, Tex., in 1971 to observe the field phase of HELBAT II. During his visit to the APG, he reviewed final results of that test and gained information on the more recently conducted HELBAT III testing held at Fort Hood.

Saintsing also viewed the foreign equipment display of the U.S. Army Ordnance Center and School Museum, and toured the aircraft park of the Vulnerability Laboratory, Ballistic Research Laboratories.

Maryland Governor Recognizes Edgewood Welding Achievements

When Maryland Governor Marvin Mandel designated a 1972 National Welded Products month, he presented the proclamation to Francis B. Gurtner, a welding engineer at Edgewood Arsenal, Md.

Employed at the arsenal since 1964, Gurtner is chairman of the Maryland section of the American Welding Society, and is active with the American Ordnance Association and the Welding Research Council.

According to Gurtner, who is recognized as the first registered professional welding engineer in Maryland, more than 31 alloys, including the first technological breakthrough in new filler metal for brazing aluminum, have been developed at the arsenal.

The proclamation paid tribute to the more than one million men and women engaged in the art and science of welding.

SCIENTIFIC CALENDAR

36th Conference and International Congress of the International Federation for Documentation, Budapest, Hungary, Sept. 1-13.

12th International Congress of Internal Medicine, Boston, Mass., Sept. 5-8.

Technical Conference on Power Generation, sponsored by IEEE, Boston, Mass., Sept. 10-14.

Astrodynamics Conference, sponsored by AIAA and AAS, Palo Alto, Calif., Sept. 11-12.

Atmospheric Flight Mechanics Conference, sponsored by AIAA, Palo Alto, Calif., Sept. 11-13.

Aviation and Space Conference, sponsored by ASME, Anaheim, Calif., Sept. 11-13.

IEEE Computer Society Conference, San Francisco, Calif., Sept. 12-14.

7th Aerodynamic Testing Conference, sponsored by AIAA, Palo Alto, Calif., Sept. 13-15.

Symposium on Instrumentation for Airbreathing Propulsion, sponsored by AF Aero Propulsion Lab., Naval Air Systems Command, USA Aviation Material R&D Lab, ONR, AFOSR and NASA Lewis Research Center, Monterey, Calif., Sept. 19-21.

Western Electronic Show and Convention, Los Angeles, Calif., Sept. 19-22.

National Environmental Information Symposium, sponsored by EPA, Cincinnati, Ohio, Sept. 24-27.

5th Annual Conference on Microprograming, sponsored by AMC and IEEE, Urbana, Ill., Sept. 25-26.

7th Intersociety Energy Conversion Engineering Conference, San Diego, Calif., Sept. 25-29.

Supplemental Papers

(Continued from page 72)

AUTHOR: HAYON
US Army Natick Laboratories

ABSTRACT: The azide radical is usually postulated as a primary intermediate in the thermal and photochemical decomposition of ionic azides. Its annihilation is ascribed to the highly exothermic process: $2 N_3 \longrightarrow 3 N_2$
The first evidence is presented for the detection of N_3 radicals in solution. Photoionization occurs at $\lambda < 230$nm, where N_3^- undergoes a CTTS type of excitation: $N_3^- \xrightarrow{h\nu} N_3 + e^-_{aq}$. The N_3 radical was observed using flash photolysis technique, $\lambda_{max} = 278$nm and $\epsilon = 2.3 \times 10^3 M^{-1} cm^{-1}$. Using the technique of pulse radiolysis, the N_3 radical was also produced from the reaction $N_3^- + OH \longrightarrow N_3 + OH^-$. It decays by a second-order process with $2k = 9 \pm 1 \times 10^9 M^{-1} sec^{-1}$. Concomitant with the decay of N_3 is the formation of another intermediate X with λ_{max} at 242nm, produced by a second-order process, $2N_3 \longrightarrow X$, with $2k = 1.3 \times 10^{10} M^{-1} sec^{-1}$, X decays by a first-order process to give nitrogen, $X \longrightarrow 3N_2$, with $k = 3.6 \times 10^3 sec^{-1}$, i.e. $t_{1/2} \sim 200$ µsec. Dimerization of N_3 ($2N_3 \longrightarrow 3N_2$) is not forbidden by spin conversation rules, thermochemically is highly favorable, $\Delta H = -210 \pm 6$ kcal/mol, and could account in part for the explosion and detonation decomposition of azide crystals. The cyclic versus extended structure for $X = N_6$ will be discussed.

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TITLE: Explosive Excavation Development for Construction and Combat Applications
AUTHORS: LaFRENZ and DAY
US Army Engineer Explosive Excavation Research Office

ABSTRACT: The Corp of Engineers through the US Army Engineer Waterways Station Explosive Excavation Research Office (formerly the Nuclear Cratering Group), is developing chemical explosive excavation as a construction technique using as a base the techniques and knowledge acquired in chemical explosive cratering tests of the nuclear excavation program. Large chemical charges are being used in multiple charge designs in a variety of media and topographic situations to achieve actual construction projects. The target is the development of chemical and nuclear explosive excavation as accepted cost competitive construction techniques.

This new technique has been demonstrated on a 1370-foot channel, a small boat harbor in coral medium in Hawaii, three railroad cuts through a sandstone and shale medium in Colorado and a channel plug project in North Carolina. A cost analysis shows a unit cost reduction trend for chemical explosive excavation compared to a unit cost increasing trend for excavation by conventional means.

Military research using explosive excavation is also conducted to apply this technique to both military engineering for combat purposes and military construction. Considerable research has also been conducted to develop a chemical explosive configuration to simulate ADM's. The information gained from both the civil and military research is integrated into the overall development of explosive excavation.

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TITLE: A Unified Mechanism for the Process of Calcification in Hard and Soft Tissues.
AUTHORS: LEONARD, WADE, HEGYELI, BOKE, and RUDERMAN
US Army Medical Biomechanical Research Laboratory

ABSTRACT: A unified mechanism for the process of calcification in hard and soft tissues is presented. In the process, adenosine 5' triphosphate (ATP) present at the mineralizing site first complexes

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Supplemental Papers

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calcium. The complex is hydrolyzed to calcium acid pyrophosphate and then to hydroxyapatite. In the process, adenosine and orthophosphoric acid are formed which react to regenerate ATP. It is proposed that the rate of the process is a function of the product of the relative ratio of magnesium to calcium at the reaction site, and the relative ratio of the formation constants of MgATP and CaATP. Based upon this product, relative propensities of various soft tissues to calcify have been predicted. Experimental tests of the mechanism have been carried out using three models, a hard tissue model, a soft tissue model and an organ culture system. Results indicated that calcification can be initiated by elevating the CaATP concentration at a local site and inhibited by enhancement of the magnesium to calcium ratio. The postulated biochemical pathway has been verified experimentally. The data obtained are generally consistent with the proposed mechanism, which provides a rationale for ongoing experimental and clinical studies directed toward the repair of bony defects and treatment of soft tissue calcification resulting from trauma.

TITLE: Ocular Hazard of the GaAs Laser
AUTHORS: LUND, CARVER and BEDELL
Frankford Arsenal

ABSTRACT: Because of its small size, simplicity of operation and inherent solid state reliability, the Gallium Arsenide laser is being actively investigated as an illumination source for tactical devices. Hitherto no investigator has determined the ocular hazard presented by this laser. This paper presents the first such determination.

A state-of-the-art GaAs laser diode was incorporated into a system specially confirmed and instrumented to deliver the maximum power density to the retina of experimental animal eyes in controlled dosages. The laser was operated in a high repetition rate pulsed mode. Threshold experiments were conducted at exposure times of 0.125 sec, 0.5 sec, 1.0 sec and 5.0 sec.

TITLE: Development and Validation of Mathematical Models of Howitzer, Medium, Towed: 155mm, XM198
AUTHORS: NERDAHL and FRANTZ
US Army Weapons Command

ABSTRACT: Development of mathematical models of the XM198 Howitzer and its recoil mechanism is described along with the basic modeling rationale. These models were used to define the required control function, to size the flow control orifice areas, to predict the functioning of the hydropneumatic recoil mechanism, and to predict weapon motion in terms of three degrees of freedom. The necessity for quantitative confirmation of prediction accuracy is discussed and the basis for model validation by comparison of predicted values to actual test data is established. Specific examples of the correlation obtained and benefits derived are illustrated.

Predictions of significant parameters are of sufficient accuracy in timing and magnitude to be of value to the weapon designer. These models are applicable with only minor modifications to weapons having a similar configuration and are a valuable tool for establishing and evaluating future artillery designs.

TITLE: Carbon Fibers: Reexamination of the Critical Low-Temperature Stabilization of Polyacrylonitrile
AUTHORS: PERKINS, SACHER, SHUFORD, THOMAS and WENTWORTH
Army Materials and Mechanics Research Center

ABSTRACT: As a fundamental part of a program for producing a high strength and high modulus carbon film for use in critical areas in advanced composite structures, a study is being made of the basic chemical and physical changes involved in producing this and other forms of carbon and graphite, in particular, carbon fibers. Critical

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Reader's Guide . . .

Laser-Induced Damage Told In Symposium Proceedings

Proceedings of a symposium sponsored by the American Society for Testing and Materials and the National Bureau of Standards (NBS), held May 19–20, 1971, are reported in detail in a recent NBS Special Publication 356.

The 174-page publication includes the 17 papers presented during the symposium on topics related to laser-induced damage in glass, crystalline materials, nonlinear optical materials, thin film dielectric coatings, and mirrors. The formal papers and discussions of the Third Annual Symposium on Damage in Laser Materials are fully reported.

Representing a major source of information in the field of damage to laser materials, the publication can be ordered prepaid ($1.50) from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 or local U.S. Department of Commerce Field Offices as SD Catalog No. C13.10:356.

Microfiche copy may be ordered prepaid for 95 cents each from the National Technical Information Service, Springfield, Va. 22151, as NBS Special Publication 356.

First Phase of Project RELAY Described in HumRRO Bulletin

"A Descriptive Analysis of the Classification, Assignment, and Separation Systems of the Armed Services" is the title of Human Resources Research Organization (HumRRO) Technical Bulletin 71-8.

The report describes research done by HumRRO for the U.S. Air Force on the first phase of Project RELAY: The Impact of Military Service on Occupational Aspirations and Development of Skills.

Over-all purpose of the research is to increase the degree of benefits of an occupational nature achieved by military personnel, during and after active duty, through improvements in the interface between military and civilian occupational manpower systems.

Paper by Picatinny Chemist To Appear in Volume of Readings

"The Discovery of a New Class of Compounds: Carboranes," a technical paper written by Jack Bobinski of Picatinny Arsenal's Feltman Research Laboratory, is among some 40 papers selected to appear in Vol. II of "Collected Readings in Inorganic Chemistry."

Scheduled for fall publication, the reprint volume is being prepared under the auspices of the "Journal of Chemical Education." Bobinski is a research chemist working on propellants development.

Computer Utilization Ideas Listed in NBS Science Series

New ideas in the use of computers in engineering, architecture and planning are presented in the National Bureau of Standards (NBS) Building Science Series 39, issued in October 1971.

The 826-page publication is edited in a form intended to serve the needs of consulting firms, government agencies, research organizations, and industrial firms. It includes the 59 papers of the 1970 symposium sponsored in Gaithersburg, Md., by NBS, the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., and the Automated Procedures for Engineering Consultants, Inc.

Copies at $7.75 each may be ordered prepaid from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, or local U.S. Department of Commerce Field Offices as SD Catalog No. C13.29/2:39; Stock Number 0303-0926. Microfiche copy may be ordered prepaid for 95 cents each from the National Technical Information Service (NTIS), Springfield, Va., 22151, as NBS BSS-39.

EPA Publishes Report On Water Quality Study

Water quality is the subject of a 500-page report published by the Environmental Protection Agency (EPA) designed to provide rapid access to information on the effects of chemicals on fish and other aquatic organisms.

Resulting from a study sponsored by the Manufacturing Chemists Association and carried out by the Columbus Laboratories of Battelle, the report lists several thousand substances by chemical and trade name along with the specific effects they produce in aquatic life.

Collected from approximately 1,000 references, the data represent studies on water pollution ranging geographically from the Nile in the Sudan to streams in South Carolina and Florida.

Copies of the report, "Effects of Chemicals on Aquatic Life," Water Quality Criteria Data Book, Vol. 3, No. 18050GWV05/71, are available from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402 at $3.75 per copy.

HumRRO Report Describes Stadimetric Training Study

Three experiments of reduced-scale stadimetric ranging training conducted for a criterion range of 1,500 meters are described in Human Resources Research Organization (HumRRO) Technical Report 71-24.

Sponsored by the Office of the Chief of Research and Development, the studies included a full-scale performance test with jet aircraft. For each experiment, the report details the problem, method, results and discussion, and lists conclusions. Copies are available from: HumRRO, 300 North Washington St., Alexandria, Va. 22314.

Supplemental Papers

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areas where film carbon is desired are joints, attachment areas, and cut-outs.

This report describes our findings upon reexamining the important first stage in producing carbon fibers from the present preferred precursor, polyacrylonitrile (PAN), the low-temperature (200-300°) stabilization in air. Inconsistencies exist between facts and the best current theories of the nature of the stabilization mechanism.

We present new data indicating at least two successive reactions, the first involving polymer dehydrogenation which can occur through reaction with oxygen or by internal oxidation-reduction; and new mechanisms supported by evidence from many analytical techniques including such high resolution electron micrographs that the changes in the polymer chains can be observed on the molecular level.

The results of the study have been applied successfully to PAN film, the first material investigated as a sheet-carbon precursor.

TITLE: Laboratory Research on the Incineration of Mustard
AUTHORS: SASS and DAVIS
Edgewood Arsenal

ABSTRACT: Laboratory studies were required to supply a near simultaneous feed of fundamental research information during design and fabrication of incineration equipment for the destruction of mustard [bis (B-chloroethyl) sulfide; HD]. On the basis of actual laboratory investigations, it has been shown that a mustard destruction efficiency of better than 99.9994% can be assured at a burning temperature of 800°C (1472°F). This level is limited only by the detection threshold for HD (parts-per-billion). Calculations for a residence time of 0.14 sec indicate that incineration efficiency which is orders-of-magnitude higher can be expected at this temperature. Scrubber tests show that both aqueous sodium hydroxide and sodium bicarbonate allow collection efficiencies of the products, hydrogen chloride (99%+) and sulfur oxides (95%+), indicating total mineralization of mustard agent. Analytical methods developed or adapted for these studies were directly applicable for stack and perimeter monitoring of effluent.

TITLE: Problems in the Arbovirology of the Bonneville Basin, Utah
AUTHOR: SMART
Deseret Test Center

ABSTRACT: Pertinent to the Army's arbovirological survey of the Bonneville Basin, Utah the problems of data interpretation placed the requirement for the following elucidative studies:

(1) Experimental clarification of serodiagnostic titer relationships in mammals was approached as a study comparative haemagglutination inhibition antibody response to experimental Venezuelan virus infection in coyotes. The Kaolin serum extraction method was not significantly superior to other methods used; haemagglutination inhibition titers of less than 1:320 may not be indicative of significant neutralizing antibody. (2) Limited Venezuelan virus dose-response infection experiments were performed on native rodents using a mutant of the VE virus of reduced virulence. Among those animals receiving 600 and 60,000 PFU that survived, all had neutralizing and haemagglutination inhibiting antibody titers 136 days after challenge. In those animals receiving the low inoculum of 6 PFU, only the Grasshopper mouse showed significant neutralizing antibody at 21 days.
(3) Experimental interference studies were conducted regarding Western Venezuelan and California encephalitis virus interference phenomena in both suckling mice primary chick cells. The results and conditions of single and reciprocal interference are discussed.

TITLE: Scattering of an Electromagnetic Pulse (EMP)
AUTHOR: STARK
Harry Diamond Laboratories

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Supplemental Papers

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ABSTRACT: The problem of scattering of EMP by apertures is investigated both from an experimental and analytical approach. The specific geometry selected is that of a rectangular aperture in a structure which is large compared to the dimensions of the aperture. The incident EMP is normal to the plane of the aperture with its electric field vector polarized perpendicular to the length of the aperture. Measurements of the scattered field inside the structure were made at many points for various sizes of apertures ranging from 1 m to 2.4 m in length and 1.5 mm to 15 cm in width. Computations of the scattered field were based on the theory of scattering of the field by a rectangular aperture in an infinite plane. Comparison of theory and experiment shows good agreement for the geometries considered.

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TITLE: The Adsorption and Reaction of Unsaturated Cyclic Hydrocarbons on a Fuel Cell Electrode
AUTHORS: YORK, BARGER and WALKER
Fort Belvoir

ABSTRACT: Direct hydrocarbon-air fuel cells may, in the future provide the Army with a silent electric power source. To achieve this goal, anode electrocatalysts must be able to utilize and tolerate the wide variety of hydrocarbons found in military logistic fuels. An understanding of the electrode processes must be gained such that maximum catalytic activity can be realized. This paper describes an effort to more fully understand the mechanism of hydrocarbon adsorption and oxidation at an electrode.

The adsorption and reaction during cathodic pulse of certain 1, 2- and 2, 3-dimethylcycloolefins and ortho-xylene at a Teflon bonded platinum fuel cell electrode have been studied. The virtually identical pulse products obtained with the dimethylcyclohexyl reactants and with ortho-xylene suggest that a common intermediate occurs in their reaction. A mechanism of reaction is postulated with incorporates that dehydrogenation of the cyclohexyl compounds on the electrode surface to a π-bonded aromatic intermediate.

A novel molecular rearrangement of a cyclopentyl adsorbate by incorporation of a methyl side chain into the ring is postulated to be a consequence of the stability of such a π-bonded aromatic intermediate. Other ring size systems are currently under study to determine the generality of the rearrangement to cyclohexyl derivatives.

Computer Programing Publications Listed

Heading a list of books on communication concepts, language and media, recently announced by the Hayden Book Co., Inc., is "Modern Data Communication" by William P. Davenport.

This comprehensive and practical source provides a fundamental working knowledge of how business and technical information is transmitted and received through electrical and electronic systems.

Other texts on the current list are:

"Beginning Fortran," by John Maniotes, Harry B. Higley and James N. Haag. This new text teaches computer programing in GOTRAN, a subset of FORTRAN that can be mastered in 10–15 classroom hours.

"Discovering Basic," by Robert E. Smith, is a practical, up-to-date course on programing. It covers a wide range of interests, with exercises that reflect the growing importance of BASIC as a language used with time-sharing systems.

"Basic Basic," by James S. Coan, is a text adapted to already established math courses, or it can be taught as a separate programing course.

"Comprehensive Standard FORTRAN Programing," by James N. Haag, contains a thorough course in FORTRAN IV. It provides a basis of mastery of the 32 different FORTRAN IV instructions as well as an understanding of computer capabilities and limitations.

"Comprehensive FORTRAN Programing," by James N. Haag, is a text immediately requiring the reader to write a complete program. The book teaches the language as specifically used by the IBM 1620 compiler with an attached 1311 Disk Drive, with adaptations to suit other systems.

"Standard Dictionary of Computers and Information Processing," by Martin H. Weik (U.S. Army Research and Development Information Systems Office), is a definitive computer reference work. It includes more than 10,000 hardware and software terms in general use throughout the burgeoning field of computers and their applications.

"Understanding Digital Computers," by Ronald Benrey, is a comprehensive guide for those seeking an in-depth understanding of computers.

"Computer Arithmetic," by Henry Jacobowitz, offers a refresher course in the basic operations of all positional number systems with applications in computers.

"Computer Numbering Systems and Binary Arithmetic," by Training Systems, Inc., and Stanley L. Levine, is a programed course proceeding gradually through all the required mathematical processes.

"Principles and Applications of Boolean Algebra," by S. A. Adelfio and C. F. Nolan, describes, in simple terms, the basic mathematical concepts involved in the development of logic systems and applies them to basic electronic circuits.

"Digital Magnetic Tape Recording," by Bernard B. Bycer, believed the first book devoted solely to digital tape recording and design, describes functions and operations in terms of basic mechanic, magnetic, electronic, and computer techniques.

"How to Build A Working Digital Computer," by Edward Alcosser, James P. Phillips and Allen Wolk, describes a unique way to learn how and why computers work.

"Basics of Digital Computers," by John S. Murphy, is a 3-volume text in the fundamentals for the trainee or student, and a comprehensive refresher for more experienced personnel.

reader's guide

SIAF Procedures Described In ARPA-Funded Study Report

Procedures for selecting and training personnel to serve in Small Independent Action Forces (SIAF) are described by the Human Resources Research Organization (HumRRO) in a recently published Technical Report 72-2.

Titled "Selection and Training for Small Independent Action Forces: Final Report," it summarizes all activities performed by the HumRRO staff during a 3-phase project. It explains in detail the third phase of the project, which included a composite test developed for evaluating the effectiveness of SIAF training. In addition, screening procedures developed for selection purposes are reported.

The Advanced Research Projects Agency, Office of the Director of Defense Research and Engineering, sponsored this project. Copies of the report are available at: Human Resources Research Organization, 300 North Washington St., Alexandria, Va. 22314.

PRESSURIZED POD:

New Portable Field Shelter Accepted For Use of Troops Against CB Agents

Protection to 10 or more persons against chemical and biological agents is provided by a portable field shelter that has been accepted for Army-wide use.

Designated the M51 Collective Protective Shelter System (CB Pressurized Pod), it has been developed by Edgewood Arsenal's Development and Engineering Directorate and the American Air Filter Co., Inc., St. Louis, Mo.

Designed for worldwide usage, the shelter serves such applications as a medical aid station, rest and relief station, command post, communications center or air operations center.

Completely self-sufficient, the unit is equipped with an environmental control system that can provide up to 60,000 BTU/hr of heat and/or 44,000 BTU/hr of air conditioning. Depending upon the application, it can accommodate as many as 10 personnel in 210 square feet of available floor area.

In a rest and relief application, the pod could provide combat troops wearing protective masks or clothing for extended periods in contaminated areas with a toxic-free area to eat, shave, smoke and perform assigned duties.

The 300-pound shelter and 200-pound airlock packages are stored on a utility trailer. The system can be transported in conventional aircraft or by helicopter and parachuted to remote sites. It can be unpacked, assembled and put into operation by 5 men in about 30 minutes.

Usable for 24 hours without servicing, the system is designed to operate for 500 hours with only routine maintenance. Major mechanical components, such as the gasoline engine, require an overhaul every 1,500 hours.

Shaped like a quonset hut, the shelter is made from flexible laminated materials with dual walls supported by tube-like ribs inflated with filtered air to make them rigid. The end walls form an integral part of the main arched section of the shelter. Additional units may be attached together end-to-end to provide a large protected area.

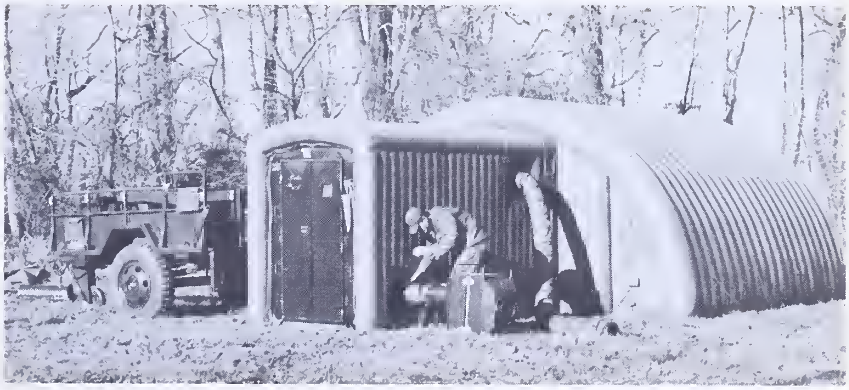
The airlock is attached to one end of the shelter providing a capability for contamination-free entrance and exit. To prevent entry of contaminants, filtered and conditioned air inside the shelter and air lock is pressurized higher than the outside air.

The complete unit consists of the shelter and air lock, a gas and particulate filtration unit, an environmental control unit, a 20-hp standard military gasoline engine that powers a 7.25 kw electric generator, and a standard military 1½-ton, 2-wheel cargo trailer.

A cover is provided for the trailer to prevent contamination while passing through areas exposed to chemical or biological agents and to prevent damage to the shelter from rough terrain.

Before being declared suitable for U.S. Army use, 15 shelter systems were put through 13,000 hours of engineering and service tests by the U.S. Army Test and Evaluation Command at Fort Knox, Ky.; Arctic Test Center, Alaska; Tropic Test Center, Panama CZ; and Deseret Test Center, Dugway, Utah.

TOP: M51 Collective Protective Shelter System is removed from utilities trailer and the laminated pod is stretched out. LEFT: Air-lock entrance to the shelter is erected before the main housing is inflated. BELOW: Air duct to the shelter is connected and final adjustments are made to the filter unit of the air lock. Designed for worldwide use, the shelter serves as a medical aid station, rest and relief station, command post, communications center or air operations center.



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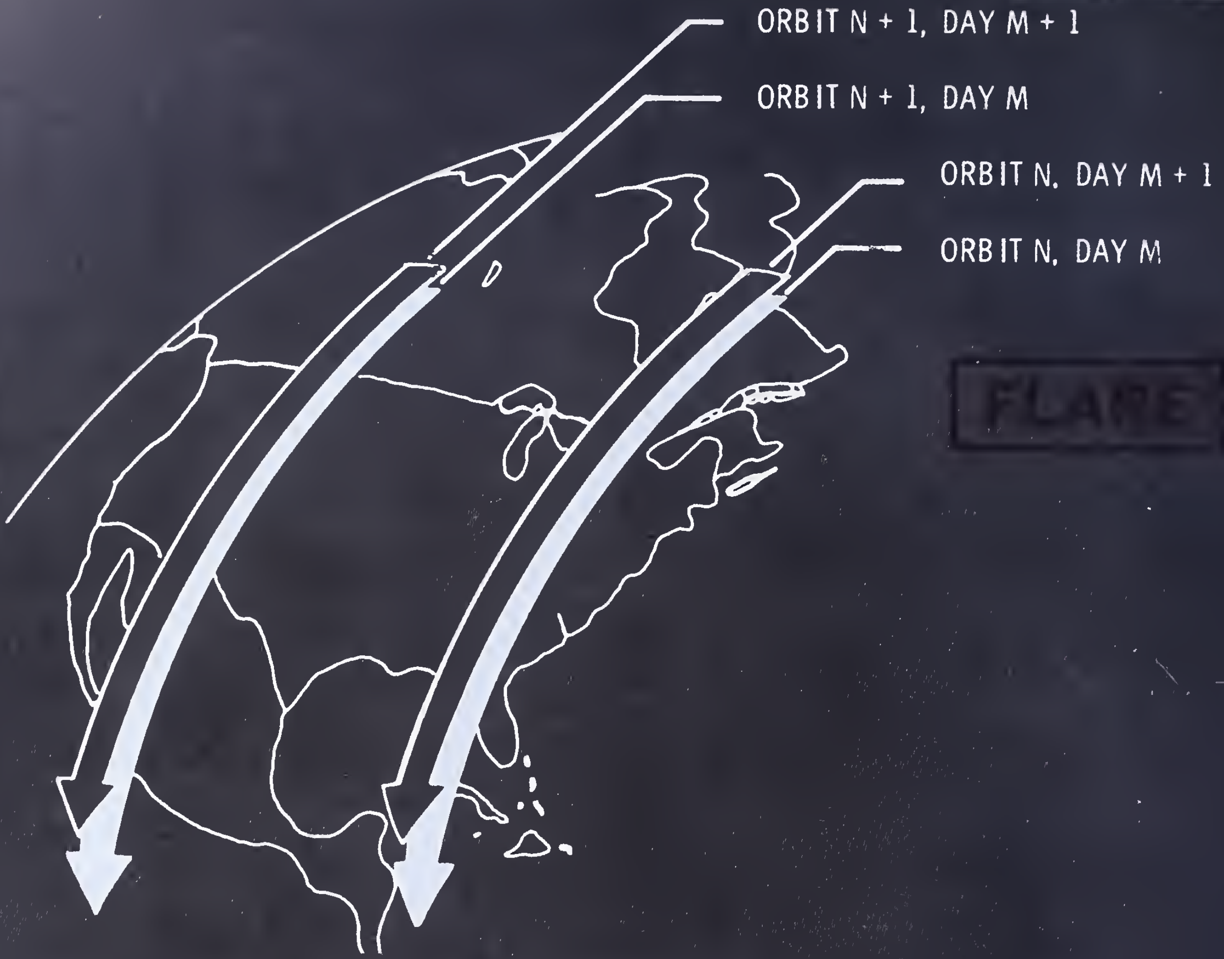
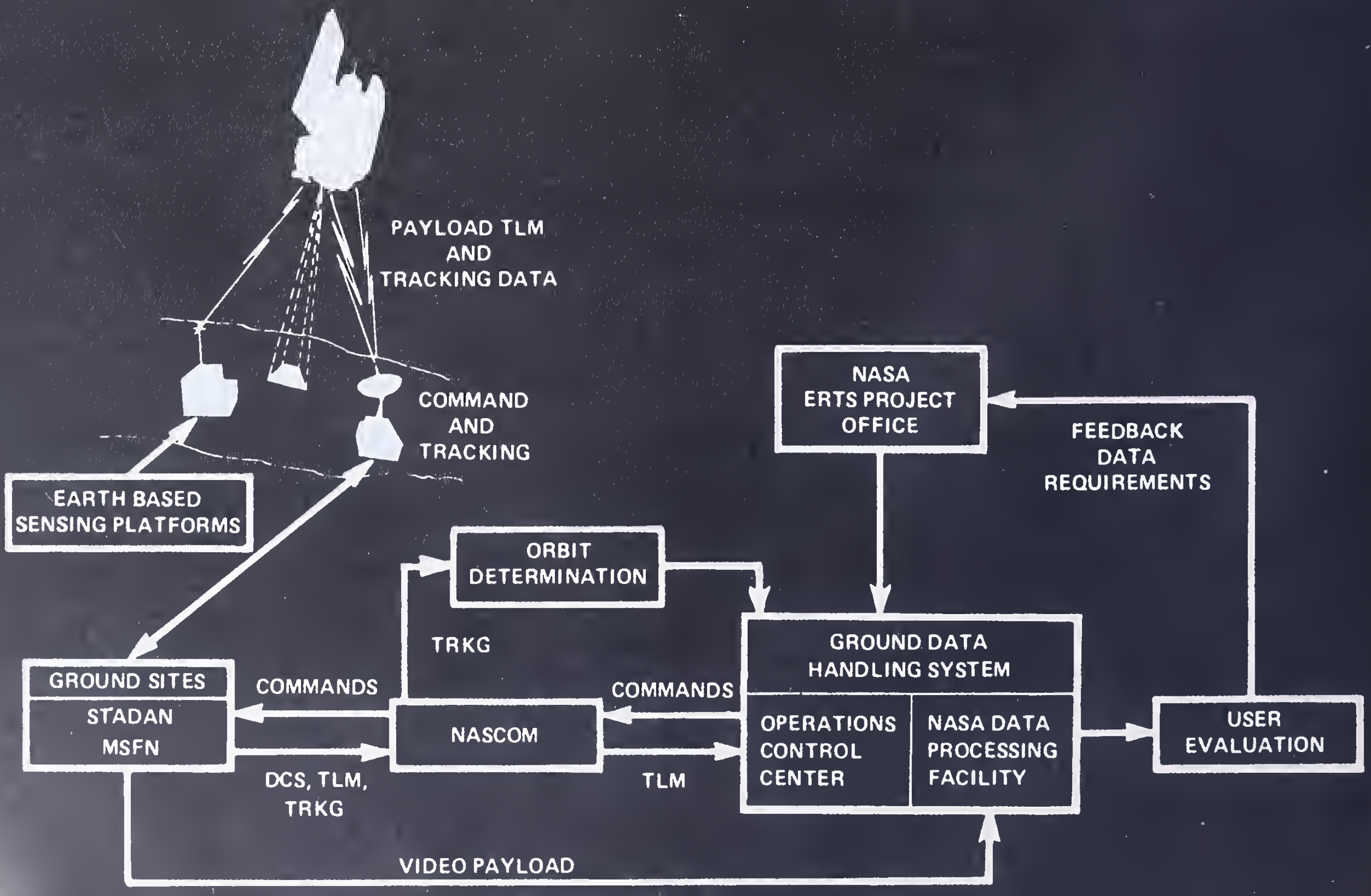
ERTS
GROUND COVERAGE PATTERN



FLARE

ERTS SYSTEM


PAYLOAD TLM AND TRACKING DATA
COMMAND AND TRACKING
EARTH BASED SENSING PLATFORMS
NASA ERTS PROJECT OFFICE
FEEDBACK DATA REQUIREMENTS
ORBIT DETERMINATION
TRKG
GROUND DATA HANDLING SYSTEM
GROUND SITES
STADAN
MSFN
COMMANDS
NASCOM
COMMANDS
OPERATIONS CONTROL CENTER
NASA DATA PROCESSING FACILITY
USER EVALUATION
DCS, TLM, TRKG
TLM
VIDEO PAYLOAD